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Optimization of Business Operations

Experience, 1959, in Automatic Data Processing

The Probable Effect of Automatic Computers on the Professions

News of Computers and Data Processors: ACROSS THE EDITOR'S DESK

JULY
1960
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VOL. 9 - NO. 7 & 7B

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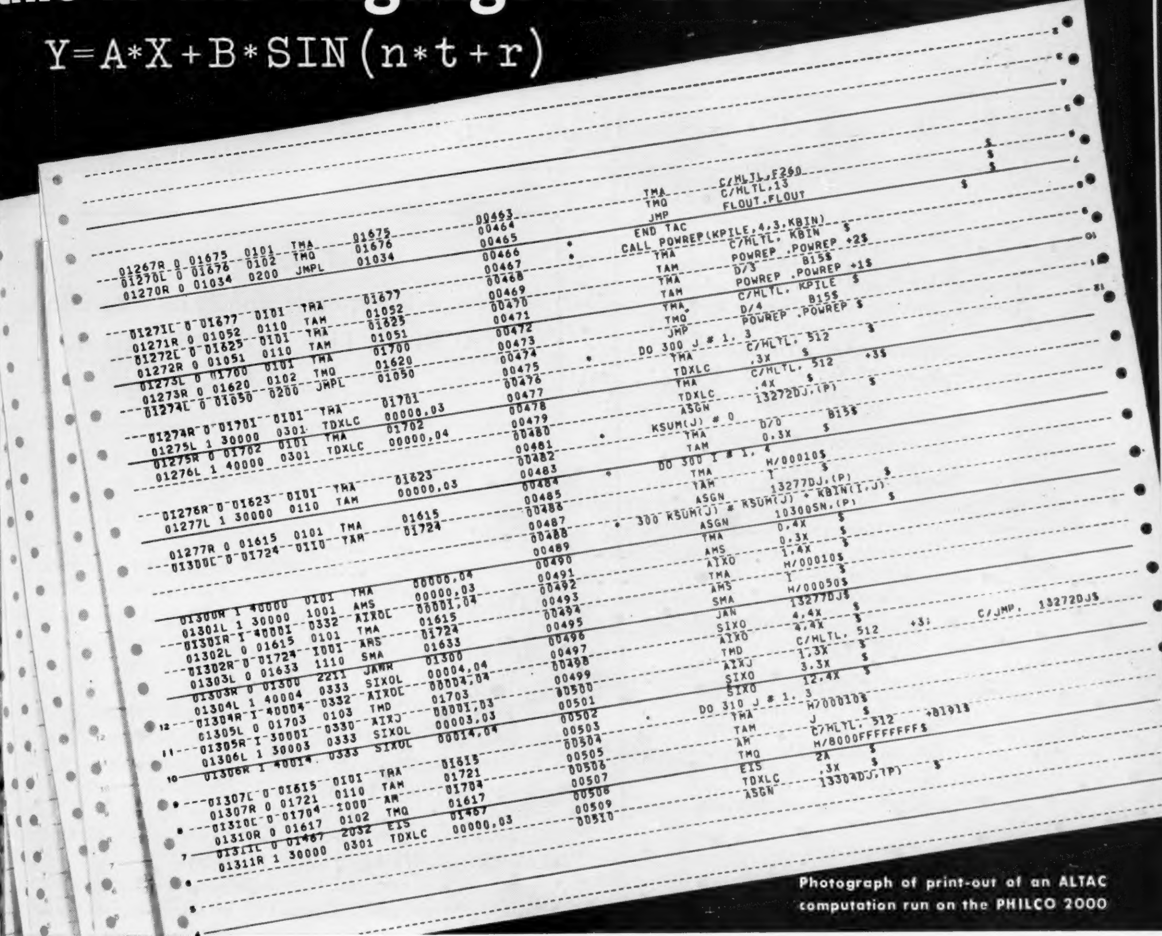

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Optimization of Business Operations

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Introduction

From the point of view of a pure mathematician, the optimization of business operations presents no difficulties. Well-known techniques of analysis are sufficient to solve practically every problem in this area. However, the practical application of these pure mathematics techniques to business operations of even moderate complexity would require a prohibitive amount of time and money.

Therefore, applied mathematicians have been interested for a long time in finding applied mathematical optimization techniques which would be of practical use. Not only have they been quite successful, but the emergence of electronic digital computers has changed the size and complexity of operations which can be optimized with these techniques for a relatively small expenditure in time and money.

It is both possible and feasible today, for example, to optimize the operations of an integrated oil company on the basis of a very large and realistic mathematical model.

One reason for the relatively few applications of mathematical tools to the optimization of business or industrial operations is not the lack of practical mathematical techniques; it is rather the fact that, traditionally, mathematicians have been poor salesmen outside of their own profession. They usually have great difficulties in dropping the technical jargon and in speaking a language that prospective customers can understand.

Secondly, many operating managements have not yet been fully exposed to the basic concepts of the optimization approach, although they are well versed in the traditional case-study methods of evaluating economic and other consequences of a given operating plan. Quite often the questions asked by operating management are worded in terms of the case-study approach: they are not stated in terms of the optimization problem they represent. For example, an operating executive may ask "What is the margin of crude oil *A* at refinery *X*?"; but what he really wants to know is "How profitable is it for the company to buy 3 spot cargoes of crude *A* during the next quarter at a given discount, delivered to refinery *X*?" To answer the question he asks, the standard procedure consists of calculating an average profit per unit of crude oil *A* processed at refinery *X*. But in many cases this average-unit profit is quite different from the incremental-unit profit which is the pertinent concept in this problem, and which will tell him the information he really wants to know. Using a computer and modern techniques, it is more likely than not that the real question in the executive's mind can be answered directly by the optimization approach within minutes and without the need for any extra computer time — because the necessary information became available when the most profitable operating plan was calculated.

Last but not least, the needs of the customer have not always been fully appreciated by the mathematical model builders. Operating managements at different organizational levels within a given company have entirely different accuracy requirements for most profitable operating plans. These differences are due mainly to the number of intangible factors which are part of the real problem, but not part of the mathematical model representing this real problem. The amount of forecasted data with inherent inaccuracies needed in a mathematical model does also affect greatly the accuracy which can be expected of the answers.

Mathematical Models

The first step in the application of mathematical tools to the optimization of operations is the creation of a mathematical model. In many instances, this step does not receive the attention it deserves.

A model (mathematical or other) is an abstraction. In some sense it duplicates a situation under investigation. No model is the real world. It only retains what the investigator considers to be the important and relevant aspects of the real world. A model for a given situation is neither true nor false; either it is applicable to a given situation, i.e., representative of reality, or it is not. The same statement is true of the assumptions on which a model is based. At worst, assumptions may be contradictory or not logically consistent. Then any model is worthless.

Depending on the purpose for which it is to be used, the same model may be representative of reality in one case and completely inadequate in another case. For example, a road map of the United States is sufficient to help a driver decide how to proceed from New York to Los Angeles; but it is totally unsuited to finding a given street address in either city.

Accuracy of Models

When evaluating the need for, or a possible benefit from, a mathematical model, we should consider not only the accuracy inherent in the model itself, but also the necessity or desirability of providing any particular degree of accuracy. Sometimes extreme accuracy has very little influence on the outcome of a decision, while the cost of obtaining such accuracy may be considerable. Therefore, there is a natural limit to the need for accuracy of most mathematical models. If the accuracy is increased beyond this natural limit, there is no longer any additional return for the additional investment to produce increased accuracy.

The inherent inaccuracy of the input data may also limit the accuracy of the results. A one-percent change in forecasted product prices may well cause as much as a 10-percent change in the final result. If we now increase the accuracy of all other input data beyond this practical limit, we achieve little or nothing.

There is some superficial attractiveness in using the latest, most detailed data with a mathematical model. Followed consistently, this policy has little merit. The proposition has to be modified to indicate the best available relevant data. This means that a set of data influencing the final result about ten times as much as another set ought to be about ten times as accurate also. The same observation applies to assumptions of a mathematical model. Unless all relevant factors of the physical problem have been considered, the resulting mathematical model may be far from useful.

A model based on relevant assumptions and on relevant data is said to be balanced. To be of any practical use, the design of any model has to be frozen at a given time when the model is put into production. If necessary, it should be replaced by a new and better model, but it should not be tampered with even if the model should turn out to be somewhat less than perfect. Otherwise, management will be confused as to what particular model is being used in the evaluations, and it will quickly lose confidence in the optimization approach.

Setting up a balanced mathematical model is still not sufficient. It must be possible to evaluate the model and to calculate meaningful answers within a reasonable amount of time and for a reasonable amount of money. Depending on the actual operation represented by the model, the meaning of the term *reasonable* varies widely.

It is possible to set up many balanced models of about the same accuracy for the same operation. The ease of calculating answers determines then which approach should be followed. There are known cases where the computing times to calculate answers for two models representing the same operation to the same degree of accuracy differed by as much as a factor of over 100. In many instances, the nature of the mathematical model is determined largely by such economic factors as the availability of a specific electronic computer or of general-purpose computer programs (such as linear programming codes), rather than by more sophisticated considerations based on the operation to be represented by the model.

Optimization Models

Optimization models are a tool of operating management. From all possible or feasible ways of running a given operation, such as that of an oil company, a tanker fleet, or an economical processing unit, optimizing models select the one which maximizes or minimizes a given quantity (usually operating profit or variable operating costs). Each organization level in a company has a need for different optimization models. The size of the models, the accuracy requirements of the user, and the inherent inaccuracies of the input data are widely different, as shown in Table I.

Table I

CHARACTERISTICS OF OPTIMIZATION MODELS

Users	*Desired Accuracy*	*Intangible Factors*	*Range of Forecasted Data*	*Model Size*
Top Management	Fair	Many	Years	Very large
Division Management	Good	Few	Months	Large
Middle Management	Excellent	None	Days	Medium to small

The factors which remain fixed or constant for all possible or feasible alternatives provided by an optimization model are not part of the problem. For example, the financing charges on a super tanker have to be paid regardless of whether the ship is in use, chartered out, or laid up. For the purpose of finding the most profitable routing of a tanker fleet, these financing charges are ignored. However, in many instances, fixed factors are introduced in a mathematical model for the purpose of convenience. For example, a raw material may be available to a given company but it must be purchased in a fixed amount due to contractual commitments. Therefore, this raw material is a fixed factor which must be part of every possible or feasible operating plan. For model-building convenience, it is standard practice to include a factor of this kind in a mathematical model.

However, there are many difficult problems in separating fixed and variable factors, such as costs, quite aside from computational convenience.

The amount of a given raw material used by a given manufacturing or processing plant, the amount of a finished product transported from a given manufacturing plant to a certain destination, or some operating characteristics of manufacturing or processing units are examples of unknowns or variables. For different possible operating plans these variables take on different values. The optimum solution is determined by the values assigned to all unknowns of the problem. In most cases, the unknowns, because of their physical meaning, can only have values which are either positive or zero. They cannot be assigned negative values. The unknowns are related to each other in the mathematical model, or they can only be assigned values within a given range. The raw materials may only be available in limited quantities. Manufacturing or processing units are usually limited in capacity. The inputs and outputs of processing or manufacturing units are related by processing relationships or equations. Each one of these restrictions is written down as an equation or as an inequality relating different unknowns to each other or limiting the values of one or more unknowns.

Each unknown of the problem may contribute to the quantity to be maximized or minimized. If raw materials are purchased, operating profit decreases by this out-of-pocket expense. The sale of products increases the operating profit. The expression for the quantity to be either maximized or minimized is called the *objective function.*

An optimization model is called *linear* when the unknowns appear only in the first power in the restrictions and in the objective function. This is equivalent to assuming that within given (small) ranges effects are proportional to their causes. Most mathematical models used up to now for the optimization of practical operations are linear models.

Besides being relatively simple and well suited to evaluation by electronic computer, linear optimization models possess another property of paramount practical significance; there can be no more than one optimum value of the objective function. In other words, if we try to maximize operating profit and succeed in finding a maximum, then we know that no other maximum exists. A nonlinear model may possess several relative maxima, which means that any computational procedure has to find all relative maxima and then compare them. The largest relative maximum is the desired optimum solution. The difference in computational effort is very significant.

The fact that a linear model possesses at most one maximum or minimum value of the objective function does not mean that there is only one possible operating plan in such a case. The solution may be degenerate. This means that there are different operating plans showing the same optimum value of the objective function. In other words, two operating plans may lead to the same profit, and there may be no other operating plan which would show a higher profit.

The optimum solution itself is of only limited value to operating management. In many instances, an optimum operating plan may not be practical because of intangible factors not included in the model. It is important to know how close alternate plans may be to the optimum, how the operating plan would have to be changed to arrive at them, and so forth. For linear models, such departures from the optimum solution are either readily available or can be calculated economically from the optimum solution. It is only during the past year or so that some linear-programming computer codes with all these desirable options have been developed and used.

Top-Management Optimization Problems

Many top-management problems are company-wide operating-profit optimization problems. What raw materials should be purchased? What products should be sold in what amounts? How should the manufacturing, processing, or transportation facilities be utilized? What is the most profitable product-distribution pattern in the sense of optimizing company operating profit? A company-wide optimization model is required to answer these and other questions. We have already seen from Table I that the forecasted data may cover years, that there are many intangible factors outside of such a model, and that only fair accuracy ($100,000 to $1,000,000 per year) is required for the optimum solution to be useful.

Even under these conditions, such an optimization model for a company with sales of the order of $500,000,000 per year consists of the order of 200 to 400 unknowns and 100 to 300 restrictions. Keeping in mind also the many departures from the most profitable operating plan that are of interest to top operating management, a linear model is at present the only practical way to find the desired answers. Even aside from practical considerations, it may be argued in many cases that no more than a linear model is needed to give top operating management the broad picture it desires as a basis for its decisions.

Together with the most profitable operating plan, some linear-programming computer codes furnish also a large amount of additional information which is readily available at little or no extra computational effort. Suppose, for example, that a company is asked to bid on a contract for 100,000 units per year of additional or incremental finished product *A* and that this additional requirement was not included in the product *A* sales forecast. The question is now one of how this incremental volume of product *A* could be produced in the most profitable way and at what price it could be sold so that all variable costs would be covered. There are, of course, many ways to produce additional product *A* within the restrictions of the model. Without using any more computer time, it is possible to tell (1) what incremental changes to the most profitable operating plan will produce one unit of additional product *A* in the most profitable manner. These are the rates of substitution. (2) How much incremental product *A* can be produced with these rates of substitution. This is the range associated with the rates of substitution. It simply means that in general incremental production cannot be increased indefinitely without making changes in the method of production itself or without being limited by capacity restrictions. (3) What increase in operating profit per unit of additional product *A* will result.

Table II shows some greatly simplified rates of substitution as an illustration. Positive numbers mean an increase. Decreases are represented by negative numbers.

Table II

RATES OF SUBSTITUTION FOR INCREASE IN PRODUCT *A* PRODUCTION

	Substitution (10,000 units/year)	Effect on Profit (Dollars/unit)
Product *A*	1.000	6.640
Raw Material *B*	0.100	–2.300
Intermediate Product *C*	0.900	–4.900
Blending Stock	0.025	–4.000
Inventory	0.040	2.500
Total Effect on Profit		2.000
Range	12.500	

(Reason for range: No more purchased intermediate product *C*)

Thus, it is possible to produce up to 125,000 units per year of incremental product *A* at an increase in operating profit of $2.00 per unit by using more raw material *B* and purchased intermediate product *C*. The volume specified in the example is well within the permissible range. The two questions of the example may therefore be answered without the need for any additional computer time.

In general, rates of substitution are available for all unknowns which do not take on positive values (they are zero) in the optimum solution (the corresponding activity is not used). For a model consisting of 100 restrictions and 250 unknowns, for example, there will be 150 different sets of rates of substitution (100 unknowns will contribute to the most profitable operating plan).

Break-even costs for the activities or unknowns used for the most profitable operating plan are also available at a small extra computational effort. Suppose, for example, that a certain class of super tankers is partially used and partially laid up in the most profitable operating plan. By how much could the lay-up costs be increased before it would become profitable to lay up fewer ships? What incremental changes to the most profitable operating plan would this entail? The answer is given by the break-even lay-up costs together with rates of substitution and two ranges: one range covers the permissible increase, the other one the permissible decreases in lay-up costs before the most profitable operating plan changes.

The ranges for rates of substitution lead to the nearest breakpoint or bottleneck. In the example of Table II, this breakpoint or bottleneck is caused by the fact that all available intermediate product *C* has been used. The rates of substitution no longer hold for increases in product *A* production in excess of the permissible range. At the breakpoint, new rates of substitution may be determined. A new range holds for these new rates of substitution. Some computer codes possess an option called *parametric linear* programming to calculate successive breakpoints to both increase or decrease product *A* production.

It is also possible to change several factors simultaneously and obtain their combined effect on operating profit. For example, product *A* demand may increase at the rate of 5 percent per year, while variable manufacturing and distribution costs increase at the rate of 4 percent per year. Again, parametric linear programming shows changes in the most profitable operating plan as a function of time.

With a little extra computational effort, it is also possible to evaluate the effect of changing properties of raw materials, specifications for finished products, or performance coefficients of the processing or manufacturing operation itself. A relatively simple variation of parametric linear programming solves this problem.

It is rather obvious that the wealth of information furnished top management by the linear-programming approach is extremely useful and at present cannot be duplicated by any other method. Most linear-programming codes for electronic computers do not permit all the options mentioned above. Relatively few overall company models are in use for routine optimization studies even though several have been developed for research purposes. On the other hand, this application offers the greatest potential pay-out from the optimization of operations.

Divisional-Management Optimization Problems

After the company-wide operating plan has been determined by linear programming, it now is feasible to tackle optimization of operations at the next lower organizational level. The divisional operating plan is based on few intangible factors. It covers a relatively short time. Therefore, a higher level of accuracy is desirable compared to the company-wide operating plan.

Optimization of divisional operations means optimizing a segment of the whole company, such as an individual refinery operation. For example, raw material may be available to the whole company in limited amounts, and several manufacturing or processing plants might find it very profitable to use this raw material. How is the allocation to be made? Unless a company-wide operating plan exists, such an allocation is difficult to make and may cost the company large amounts of potential profits.

Another difficult question centers around interdivisional transfer prices, which again cannot be well determined without an overall operating plan. Since most divisional operations are optimized in the sense of maximizing operating profit or minimizing operating expenses, it becomes more difficult to provide meaningful input data to a mathematical model of divisional operations.

Some divisional models may be very large, even larger than company-wide optimization models. Marketing distribution models especially have such a tendency. However, they exhibit a special internal structure which permits the application of special computational techniques.

Most divisional optimization models again are linear models, but in many of them special computational techniques may be applied because the basic structure of the model is not completely general.

Some of these divisional models may also contain one or more nonlinearities of such a nature that it still can be shown that no more than one optimum solution exists. Even though mathematical techniques to handle a model of this kind on a computer have been developed, they have not been used extensively. Any such method is quite time-consuming because it must accept a large variety of nonlinearities to be potentially useful. In most practical cases, nonlinearities are handled with the method described in Section VII.

Many divisional optimization models are of considerable mathematical interest, but it should always be kept in mind that departures from the optimum solution are extremely useful in this case, also, and should be furnished by any mathematical method for finding an optimum solution itself.

Middle-Management Optimization Problems

Gasoline-blending is an example of a middle-management optimization problem. In general, optimization problems at this level are of a relatively small size. No intangible factors are involved and excellent accuracy may be required. It may no longer be possible to obtain such accuracy with a linear model of manageable size.

It is beyond the scope of this presentation to enumerate the large number of different methods which have been used successfully on individual middle-management optimization problems. It has been a rather standard practice that, in most companies, optimization problems of this class have been investigated and solved long before a study of top-management or company-wide optimization problems was started. I presume that this was the result of a mistaken conviction that if middle-management optimization problems were difficult to solve, optimization problems facing top management would exhibit an even higher order of difficulty. Based on the analysis presented here, this point of view cannot be maintained. As a matter of fact, in many cases it was less difficult to prepare a useful mathematical model for top management than to prepare one for a superintendent of a small manufacturing unit, where the operation is already approaching its possible optimum as a result of trial and error conducted over a period of many years.

Preparation of Mathematical Models by Computer Program

The preparation of a mathematical model is a very considerable task in itself. If several hundred restrictions and several hundred variables or unknowns are included in

model, the mere physical transcription of the information contained in such a model from a large piece of paper to a computer input medium is a frequent source of error. Therefore, it is quite natural to ask whether or not an electronic computer cannot take over a large part of more or less routine preparation of a mathematical model.

Since the application of optimization techniques to management problems is likely to become more and more prevalent and grow much faster than the increase in the number of trained analysts, it is very likely that the average quality of the problem analyst or model builder is going to decrease with time. Therefore, another desirable aspect of a computer application is to have the computer take over some of the problem analysis itself and, whenever possible, correct for the deficiencies of the human problem analyst. It is entirely possible to set up a computer code with the following functions: (1) It uses English statements and numbers as its input and thus resembles some of the current automatic compilers in this respect. (2) It examines the input statements and makes necessary modifications to them to simplify the logic of the mathematical model. (3) It prints out a concise set of statements which would make such a modification unnecessary. In other words, the computer prints out the problem statement which the analyst should have given it in the first place. (4) It enables the computer to condense the mathematical model by automatically eliminating redundant or unnecessary statements and restrictions and thus to arrive at a mathematical model which, in many cases, is equal to the theoretical minimum size.

There are several other interesting features which can be built into an advanced matrix-building routine of this kind. Based on theoretical and computer studies, it appears that such a routine can be coded with very efficient results. In two particular test cases, the computer-built and condensed model was smaller than the corresponding models prepared by human analysts.

The matrix-builder routine can also be used to build a model consisting of a linear part and some nonlinear models for individual processing or other units. At each stage the computer will optimize the linear-programming model and then use the nonlinear models to check whether or not the proper performance coefficients have been used at the current level of operations. If changes are necessary in some of the linear-programming matrix coefficients, these changes can be evaluated quite easily and reflected in the current solution so that it will not be necessary to solve the whole linear-programming problem again. Furthermore, the most profitable operating plan does not change when finite (but sometimes quite small) changes are being made in the linear-programming matrix. Therefore, in most cases, the procedure will terminate after relatively few stages. I know of several companies which are using this approach rather than a more direct method to handle nonlinear optimization problems.

In conclusion, it may safely be said that the application of mathematical tools available today to optimize operations will be of very considerable significance in the future and lead to a considerable increase in the range of application of electronic computers to the solution of management problems.

Experience, 1959, in Automatic Data Processing — A Review

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New York 5, N.Y.

(Based on a talk given at a conference "Computers — Top Management Appraisal" of the British Institute of Management, Glasgow, Scotland, March 1960)

1959 was a good year for automatic data processing. In effect it has been a year of preparation, for most of the "developments" that were announced, publicized, and worked on in 1959 will have their actual initiation in 1960, and even later. But that is typical of automatic data processing as well as most of today's technological developments. And just as is the case with many other factors in our technological life, the technical progress continues to be much faster than its application to practical uses.

1959 saw a greater increase in the number of computers than any other previous year. This increase has taken place in all sizes and types of computers. Just to give some idea of the growth and of the extent of computer usage, here are some figures from the semi-annual census of American computers in use and on order that our company conducts.

For large scale systems, there are now 541 installed, a 71% increase over the previous year. In addition there are over 200 of the large scale transistorized systems on order. For medium scale machines, the increase over a year ago is 88% for a total of 654 systems installed, while small scale systems total about 2400, a 76% increase over the previous year.

The high on-order figures for all classes of machines concentrate on the new higher-speed, transistorized machines almost exclusively.

There are obviously other reasons for this growth than good salesmanship. The basic reasons are the same in America as in the United Kingdom and in continental Europe, although America continues to be several years ahead with respect to intensity of computer usage and applications.

New Machines

The magic word in 1959 was "transistors," so much so that a great many things have been attributed to transistors that are not directly related to them. What the "transistor" means to the businessman is, in effect, a new generation of computers with new capabilities, as a result of a whole series of technological developments, some of which are completely unrelated to electronic tube or transistor.

This new generation brings something different for each company, but in general:

a) Greater reliability — machines will make even fewer mistakes (if this is conceivable) and they will be in operating condition a greater proportion of the time (which will be helpful).

b) Lower costs of installation. This is partly because of fewer environment requirements and partly because the machine systems are smaller.

c) Lower cost per unit of performance. This has several additional implications. For one thing, the greater speed of processing permits applications that were impossible before. For instance, one utility company is now able to process 100% of its files and records each day and thereby save a huge amount of money through eliminating controls for hold-over operations, eliminating interim files and having all files up to date each morning. This would just not have been economically possible with the first generation of machines.

   Secondly, there is a tendency (and a logical one) to go from old type equipment to new, because in many cases one can do much more work for the same amount of money.

d) Greater flexibility. One machine is now able to serve many more functions than before. For example, from a technical viewpoint, it is much more reasonable to combine scientific and business applications than it was before.

If one considers the new machines that have become important factors in the market in 1959, the number is quite astounding. In the United States alone, it is tiring to go through even a partial list:

Philco Transac 2000
National Cash 304
RCA 501
IBM 7070
Minneapolis Honeywell 800
IBM 1401
IBM 1620
Royal McBee RPC 4000
Burroughs Visible Record Computer

Similar technical developments have occurred in Great Britain during 1959. Ferranti announced a new computer, the machines of Electrical & Musical Industries approached completion; English Electric will undertake production of the machine developed by RCA, and other companies either have or are considering entry into the field with new developments.

All these new machines and developments may seem to bring nothing but confusion to the manager who must make decisions concerning automatic data processing in his company. But in fact, they bring considerable advantages.

a) A wider range of machines to choose from, each with its own particular characteristics, means that it is possible to find equipment better suited to a company's specific needs.

b) The greater speed, flexibility and capacity of new equipment make it possible to come much closer to true integration.

c) Such concepts as immediate availability of information and immediate processing of data come closer to achievement.

d) Finally, much of what was not feasible or economical before becomes practical.

These are the points that should be of interest to the manager, for they represent the way in which he can improve direction and control.

Although the new computers announced or perfected in 1959 received most of the attention, there were other technical developments that were equally significant. In America, our banking system decided on magnetic ink character recognition and proceeded to develop applications around it; while in France, Compagnie des Machines Bull developed a new system of its own. Advances in the critical area of data comunication were made through new transmission devices, while industry took a step closer to integrated data processing through improved means of gathering production data from the factory for input to the automatic system. Several new systems for automatic programming were developed and, in spite of the many arguments about them, some of the accomplishments in this field are quite promising.

These technical developments have an immediate, direct bearing on today's user of automatic data processing. The number and quality is typical of a young industry on the fringe of one of the major areas of technical progress. Developments in 1960, whether or not they result in as many headlines, are likely to be even more significant.

Small Business

Directly related to technical developments and to increased competition in the computer field was an awakening of interest in the "small company," which I shall not try to define. For several years, many small companies felt that automatic data processing was just one of many factors making life in business easier for the big firm and harder for the small. Much of this was unwarranted self-pity, for service bureaus and rented time on big machines have long been available.

However, 1959 saw two developments that can bring comfort to the non-giants. In the first place, computer manufacturers have begun to develop special smaller machines. In America, the IBM 1401 is the best known example of this, a development that has been made possible only by the technical developments that are the basis for the larger machines as well. In Europe there are already other machines that are even less expensive, and no doubt this will be the forerunner of an important trend. It is reasonable to say, now, that a firm with monthly data processing costs as low as $5,000 to $7,000 would be justified in considering a computer. Previously this was not the case.

Properly used and properly approached, these smaller machines open up whole new areas and possibilities, but they are accompanied by dangers as well. Already, many firms are ordering the smallest and cheapest on the assumption that "they can't go wrong" by starting there. Others are finding a stronger reason (because it is cheap) to obtain a "computer" for the sake of having one, when conventional punched cards would do as well and cheaper. In addition, it is now easier to make a bad computer system pay. Previously, to justify an expensive machine on a sound basis, it was almost essential to do a thorough, all-inclusive system design, although there are certainly many exceptions to this statement. Today, it is even easier to avoid doing a thorough, really worthwhile job.

Data Centers

In addition to developing small machines, computer manufacturers in America have taken a new interest in the service bureau concept. These new sources of computer time are called data centers, and they are really service bureaus without the frills. The using firm does its own programming and systems work, and obtains only machine time from the data center. This enables the small and medium size firm to take advantage of the inherent superiority of the large machine.

Some similar activity on the Continent has begun, particularly in Holland, where two employers' trade associations are each obtaining a computer to perform work for their members.

There has long been a good deal of speculation about "sharing computers," and progress so far has been limited for many good reasons. In America, the possibilities are increasing, as they no doubt will in Britain as well, although at a time when the availability of smaller machines may reduce the need for sharing.

Increase of Competition

The third major development in 1959 is the increase in competition among equipment manufacturers. This is nearly always a healthy situation for the user and potential user. In the first place, the number and kinds of machines available directly increases. Also computer companies are pressed to provide even better service, not that some have not already been doing an outstanding job in this area for some time. But the Data Centers that I have just mentioned are a direct outgrowth of competitive factors, as are other "new ideas" in the service area. For instance, one of the companies in America has revised its rental contract to make prime shift rental pertain to any combination of 176 hours per month, rather than to eight or nine consecutive hours per day, each day. Such an arrangement, of small significance in itself and easily followed by the other companies, is indicative of the benefits of competition to computer users.

Competition will also have a direct effect on prices of computers, and this is one of the factors that can be of real interest to businessmen. In America we have had some formal announcements of price reductions; in Europe many of the price reductions are of the more informal, bargaining kind, although they are just as real.

The speed and intensity of research is also stimulated by this new competition. Research can result in new machines, new and cheaper ways of construction, and tremendous increases in capacity and economy. It can also produce new aids in applying existing machines to business and scientific problems.

Competition in computers has gone through two periods in America. Several companies have entered and withdrawn

from the computer field — Monroe, Underwood, J. B. Rea and others — to leave three or four dominant firms in the business data processing field. The third stage began in 1958-9, when a whole new group of powerful firms entered the field of computers for business data processing — companies like RCA, Minneapolis Honeywell on a full-scale basis, National Cash Register.

In Europe and Britain new, large firms are starting in the field, many with fine equipment and some with the force that will carry them to success. On the continent Siemens & Halske and Standard Electric Lorenz are seriously in the field, while a Swedish combination has been formed to make and market an inexpensive medium scale machine. In England, the formation of De La Rue Bull Machines Ltd. makes available in Britain a French series of machines that have proved their worth.

Whatever the outcome of all this competitive activity, one thing is certain — its practical benefits — in price, in progress, and in service — to the user are significant.

Proper Application: Information Instead of Paper Work

Technical developments, new machines, and all the results of competition and new ranges of equipment are all of no avail unless they are properly applied. For a long time, application cast a shadow over the data processing field. The lag between technical achievement and actual application was, say two years ago, so significant as to be almost dangerous. The lag still exists, but at least there have been worthwhile developments in the application of computers. Information instead of paper work is becoming the raison d'etre of more and more machine systems, and the imaginative developments in 1959 have been quite interesting.

1. A textile manufacturer in New York uses a computer almost entirely for information on inventory, sales analysis, and material available for sale. Not only has this been found to be profitable, but the company is developing new applications and further information requirements that will require a larger system in the next two years.

2. A major oil manufacturer is developing a complete program for marketing accounting that will not only reduce costs, but will provide marketing managers with up-to-date information on sales and sales tendencies all over the country.

3. A drug and consumer goods manufacturer is using a computer to keep track continually of area sales in relation to a national index of purchasing power for a given area. As soon as discrepancies are detected between actual sales and sales that should be expected, corrective action is taken and the results can be measured on a week-by-week basis.

4. Another producer of consumer goods has been able to use a computer system to determine the effect of money spent for advertising and promotion, and to test the probable effect of expenditures on different types of advertising. The result has been a significant change in his advertising and promotion policy.

5. A chemical company is developing a program for patent searches and classification that will save large amounts of the time of skilled research workers, while the computer is also being used to provide the company's customers with optimum mixes of fertilizer for specific conditions.

6. A utility company will use one of the new generation of computers to overcome the problem of providing customers with up to date, accurate answers to inquiries, in addition to performing the basic data processing work.

7. The Boeing plant in Wichita, Kansas is using direct connections from the factory floor to the data processing center in order to gather production data as part of an integrated system of production control.

Many other examples of imaginative information processing could be given. Although they remain the exception rather than the rule, many companies have made significant progress towards using some of the vast potential that computers really offer.

Difficulties

Lest all this sound like too rosy a picture, let me also sound a note of caution. Major difficulties remain to be overcome, quite apart from the technical developments that are needed (and that will come).

1. A very severe shortage of people who are qualified to develop really good automatic data processing systems still persists. People must be trained, and then they must gain experience.

2. Perhaps more important than training the systems people is the need to educate management. There is a tremendous task to be done in making management aware of what computers can do, and thus convincing them to undertake the cost and effort involved in system study and design.

3. There is also a more basic need of finding out how management makes decisions, how organizations are run, so that systems designers can have goals that represent the real data needs of the company. It is this area of management education and specialist training that remains one of the major obstacles to full use of automatic data processing.

To summarize, the last year has made a major contribution to the technology, and, more important, to the experience with automatic data processing. We are already at the stage where computers and electronic systems are no longer "experiments," and there is a solid foundation of applied, practical know-how on which to base current and future programs. Provided one is aware of the difficulties and of the ways to meet them, one can expect good results.

// NEWS of Computers and Data Processors

"ACROSS THE EDITOR'S DESK"

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CHECKING BITS WHICH CORRECT ERRORS OR BURSTS OF ERRORS IN TRANSMISSION OF DIGITAL INFORMATION OVER LINES

Advanced Systems Devt. Lab., International Business Machines Corp., San Jose, Calif.

A built-in detecting system has been developed here which detects and then corrects errors or bursts of errors that may occur during transmission of computer information over communication links.

This development renders more reliable communication between remotely located computers. Transmission errors may be caused mainly by static and short interruptions.

The detecting system consists of checking bits placed at the end of each block of transmitted information. The code considerably reduces the number of required checking bits previously required, and, therefore, differs basically from previously developed codes. The necessary additional circuitry is simple and inexpensive.

During transmission of a computer message, bits are simultaneously counted. If any bits are lost, the checking bits report the errors, locate and identify them and then make the necessary corrections. The original message and the correction bits arrive at the receiver at practically the same time.

1960 EASTERN JOINT COMPUTER CONFERENCE, NEW YORK, DEC. 13 to 15

Nathaniel Rochester, International Business Machines Corp., New York, N.Y.

The annual Eastern Joint Computer Conference (EJCC) will be held December 13-15 at the Hotel New Yorker and Manhattan Center in New York.

Abstracts of technical papers proposed for the conference should be submitted by August 13, to the technical program chairman, Elmer C. Kubie, Computer Usage Co., Inc., 18 East 41st Street, New York 17, N.Y. Subject matter of the proposed papers should concern recent achievements or techniques in the design and use of computing equipment.

In an attempt to produce a program of the highest possible quality, no parallel sessions are planned and a $300 prize will be awarded for the best presentation of a paper at the conference.

The EJCC is sponsored by the National Joint Computer Committee which consists of representatives of the Institute of Radio Engineers, the American Institute of Electrical Engineers, and the Association for Computing Machinery. The committee sponsors two meetings each year, one on the East, the other on the West Coast. More than 2,500 persons attended the 1960 Western Joint Computer Conference in San Francisco this May.

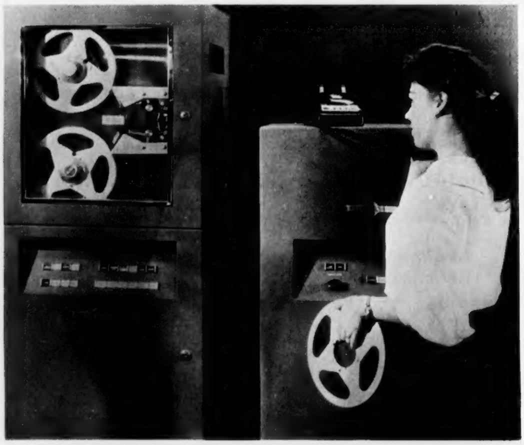
COAST-TO-COAST DATA COMMUNICATIONS NETWORKS OVER EXISTING TELEPHONE LINES

Collins Radio Co., 2700 West Olive Ave., Burbank, Calif.

Coast-to-coast networks for high-speed communication of data over existing telephone lines went into operation in May, using a tape and card system developed by this company. The speed in transmitting information in magnetic tape is 300 characters per second; the speed in transmitting information in punch cards is 100 cards per minute. The name of the system is Kinetape and Kinecards.

This system enables high-speed communication between central data processing facilities, and distant branch factories, offices, or warehouses.

The system is compatible with nearly all computers, including for example, the magnetic tape systems of IBM, Remington Rand, RCA, Burroughs, National Cash Register, Honeywell, etc.



One of the existing networks uses a Collins magnetic tape transmission system for inventory control between two Army Signal Corps supply points 650 miles apart, Philadelphia, Pa., and Lexington, Ky.; the second -- a coast-to-coast link -- sends missile design problems and answers on a Collins punched card transmission system back and forth between Charlotte, N.C. and Santa Monica, Calif. for Douglas Aircraft.

Speed in both cases is 300 characters per second, equivalent to 3000 words per minute and double the data rate of any other commercially available equipment. With this speed and capacity, it is now practical to link scattered data processing centers into an integrated system or to extend the use of a single central computing facility to distant plants, offices or warehouses.

The Army Signal Corps' tape transmission system links the Signal Supply Agency's headquarters and national inventory-control point in Philadelphia, Pa. with the Lexington, Ky. Army Signal Depot, 650 miles away. The depot in Lexington is one of the principal depots in the U.S. which stock and distribute electronic, electrical, meteorological and photographic equipment and spare parts for the Army.

Each day a reel of tape from a computer at Lexington which has recorded the previous day's supply transactions is transmitted via telephone line to Philadelphia at high speed. A 2400-foot reel representing some 25,000 transactions can be transmitted in approximately 2 hours. The supply data is then fed to a larger computer, which up-dates inventory records and produces reports for use by purchasing officers.

Before installation of the Collins tape system, punched cards requiring 8-10 hours for transmittal of information and involving several manual operations were employed. The Army Signal Corps is the first military or civilian organization to use this new data communications system.

The Douglas data networks allows engineers at the company's Charlotte plant to send missile design problems on punched cards 2200 miles over a telephone line to the Douglas computing center in Santa Monica, Calif., and get answers back the next morning. This is the first coast-to-coast high-speed card transmission system operating in an industrial application.

Design data relayed to Santa Monica for processing on IBM 704 and 709 computers include missile trajectory calculations, thermal analysis, stress analysis, guidance and control studies and test data reduction.

The engineer first outlines a problem; this information is then key-punched onto cards which are transmitted to Santa Monica. Computing is done at night and the answers, which may require up to 10 times as many cards as the input data, are immediately transmitted back to Charlotte.

Present card volume is about 20,000 per day. Full capacity of the Collins system is nearly 100,000 cards per eight-hour shift or 200 cards per minute in full-duplex operation (transmitting and receiving simultaneously).

Douglas officials point out that in addition to providing the Charlotte engineers with urgently needed answers in 4-7 days less time than before, the Collins Kinecard transmission system represented a practical, eco-

nomical solution to the problem of obtaining required computer time.

They said cost of installing and staffing computer facilities at Charlotte would be at least three times the cost of the overall data transmission system, adding that the new data communications link resulted in more efficient use of the computer center and personnel already operating at Santa Monica.

Douglas is planning for installation of an IBM 1401 data processor at Charlotte, now scheduled for early 1961, and the use of a Collins magnetic tape transmission system for even faster communication of larger volumes of data.

HIGH SPEED COMMUNICATION OVER TELEPHONE LINES

Stromberg Carlson, A Division of General Dynamics, Rochester 3, N.Y.

A high-speed binary-data transceiver that will make it possible for electronic computers and other high-speed data-handling devices to "talk" directly to each other over regular commercial telephone lines at a rate of 2400 bits per second has been developed by this company.

This new transceiver uses solid-state circuitry exclusively, and is known as the Model S-C 301.

The high speed of data transmission is made possible principally by an unusual modulation method which minimizes errors due to impulse and transmission noise, phase distortion, frequency translation, and other problems normally encountered on wire lines.

The input signal may be either polar or impulse type binary information. The transceiver accepts the data in the form of a serial train of pulses, shapes the pulses, and modulates a subcarrier frequency. No synchronizing signals are required, as the receiver portion of the transceiver has an automatic frequency control system for automatic synchronization at any bit frequency between 2350 and 2450 pulses per second.

Higher or lower bit rates can be provided on special transmission facilities by substituting plug-in components in the transceiver.

BIONICS SYMPOSIUM, SEPT. 13-14, DAYTON, OHIO

Wright Air Development Division, Wright-Patterson Air Force Base, Ohio

A symposium on the infant science of bionics will be sponsored by the Air Research and Development Command's Wright Air Development Division, September 13 and 14 in the Dayton Biltmore Hotel, Dayton, Ohio.

Bionics is a newly-defined area of applied research. It is described as a science of man-made systems which function after the manner of, or in a manner characteristic of or resembling living systems. Its objective is to apply principles discovered in the study of biological systems to engineering design. This embraces all possible biological and engineering processes, but at the present time the most interesting and promising applications are expected to come from the realm of information handling; that is, acquisition, processing, storage and utilization of all categories of data.

The use of bionics machines and systems now is becoming feasible because of increased understanding of biological system functions and increased capabilities in componentry miniaturization, communication and computer engineering. These machines and systems may be appropriate to some phases of the Air Force mission, expecially the complex problems of defense and the Air Force Research and Development program.

Persons interested in attending the symposium should communicate with the Commander, Wright Air Development Division, Attn: WWRDA (Major J. E. Steele), Wright-Patterson Air Force Base, Ohio.

CONTACT AT TEN MILLION MILES

Dana W. Atchley, Jr., President, Microwave Associates, Burlington, Mass.

The Pioneer V satellite has been successfully contacted at 10,000,000 (ten million) miles. A solid-state voltage-variable capacitance silicon diode developed by this company helped make this contact possible. Pioneer V, developed by Space Technology Laboratories, is a space probe designed to test cosmic radiation, micrometeorites, and magnetic fields in interplanetary space.

Through the use of a newly designed digital telemetry unit, the first true interplanetary communications system, contact has been maintained with Pioneer V over distances in excess of ten million miles by both the Jodrell Bank Radio Telescope in Manchester, England, and by the Space Technology Laboratories Tracking Station in Hawaii.

Communication with satellites over vast distances requires a combination of powerful transmitters and exceptionally sensitive receivers. Emphasis now is on solid-state reception devices like this special diode, called Varactor; it is used in space communications because it contributes a minimum amount of "noise" to the system. Prior to the development of this diode, it was not possible to detect such signals because receiver "noise" added to cosmic and antenna noise and camouflaged the signal. To make possible receivers which have noise levels below the cosmic and antenna noise levels, this company developed the diode.

BENDIX AVIATION CORPORATION TO BENDIX CORPORATION

Bendix Corp., Fisher Bldg., Detroit, Mich.

We're changing our name to the Bendix Corporation.

To reflect our growth in such fields as electronics, missiles and space, automotive, weapons systems, computers, machine tools, instrumentation, nuclear technology, hydraulics, meteorology, electrical, marine and others, we are dropping "Aviation" from our corporate name on June 1, 1960. We do not wish to convey the impression that our products are limited to the aviation field alone, although aviation products accounted for billings of $388,700,000 in 1959.

Today Bendix -- through 25 divisions and 16 subsidiary and affiliate companies around the world -- serves many fields.

Our success in the rapidly expanding age of aviation has long obscured the fact that the Bendix(R) automobile starter drive was the company's first major product. Bendix introduced the type of four-wheel brakes that over the years has been used on most makes of cars. Bendix also pioneered automotive power brakes and power steering. Our automotive business in 1959 totaled $114,300,000.

A notable trend in Bendix' recent history is the utilization of electronics in many of our major fields of activity. These range from automobile radios to aircraft and industrial communications and automatic flight controls...from electronic computers and data processing to numerical tape control systems for machine tools...and from transistors and ship-to-shore telephones to sonic cleaning and undersea sonar detection equipment. Approximately 40% of Bendix products are electronic, including air defense radar which today guards 25 million square miles.

Missile and space equipment accounted for $103,000,000 of our total business of $689,692,312 in 1959.

ELECTRON DEVICES MEETING, WASHINGTON, D.C., OCT. 27-28, 1960 -- SECOND CALL FOR PAPERS

H. W. Welch, Jr., Technical Program Chairman, Motorola, Inc., 8201 E. McDowell Rd., Scottsdale, Ariz.

Papers to be presented at this meeting should deal with material of an applied or developed nature in the broad field of electron devices. This includes electron tubes, semiconductor devices, masers, tunnel diodes, parametric amplifiers and other solid state device configurations. This meeting is intended not to overlap with the Research Conferences, which comprise papers dealing with new ideas and concepts. Papers for this meeting should be concerned primarily with the device itself, or important new device technology, rather than with its application or circuitry, except insofar as circuitry is built into the device itself. Papers related to microelectronics will be welcome insofar as they are specific in nature and deal with the active device.

The response to the initial call for papers indicates that we may expect another excellent Electron Devices Meeting. This is the final call.

An original and four copies of an informative abstract of approximately 200 words must be received by August 1, 1960 in order for a paper to be considered for presentation at this meeting. The abstracts should

be as factual as possible and will be used by the Committee in deciding which papers will be accepted for presentation. Please send abstracts to me.

SIMULATION OF HUMAN ARTERIES AND BRAINS

American Society of Mechanical Engineers,
29 West 39 St., New York 18, N.Y.

Engineers and physiologists meeting in Dallas, Texas, in June, decided that medical science would be in a poor state without the contributions of mechanical processes, mathematics, and computers. Far away as they seem from human life, they permit the simulation of human functions in the laboratory, with sometimes life-saving results. They may also lead the way to transferring characteristics of a human being to an "artificial brain".

Simulation of human functions is important, Ralph W. Stacy, Associate Professor of Physiology and Biophysics, and Norman A. Coulter, Jr., Assistant Professor of Physiology and Biophysics both of Ohio State University, told The American Society of Mechanical Engineers, because, in the present concept of biology, living behavior can be explained in terms of simple physical and chemical systems. They spoke to persons attending a session on June 7 at the ASME's Semi-Annual Meeting and Aviation Conference.

For example, said the authors, a human artery has been equated to a rubber tube filled with water, and for many years, studies were conducted on rubber tube systems with the express purpose of obtaining information on the behavior of living arteries. Recently, electrical impulses were used to simulate behavior of artery pulses and the system was adjusted until the pulse exactly matched that of a human being. "The success of such simulation was almost startling," said the authors.

Today, a doctor can feed data on a patient's arterial system into a computer and by determining the difference between that data and one for a normal artery can find out whether his patient's system is normal. And, perhaps in contrast to former days, "the patient is still alive", said the authors.

The future for simulation of bodily processes by formulas on a computer also looks bright, according to these authors. It may become a valuable tool to the doctor making a diagnosis. "It is conceivable that after ten or twenty or fifty years of development ...a physician can collect data on a patient whose diagnosis is not obvious...then transmit these data to a central medical computing agency. The computer then...returns to the physician an analysis stating the most probable diagnosis, the probability function associated with this diagnosis, a second most probable diagnosis with similar information, and perhaps even a recommendation for further data collection or for treatment."

The scientists concluded "Perhaps at this point, we may be permitted to speculate even further. The ultimate step in the process of simulation would be the design of an artificial brain. This is far beyond present knowledge, of course,...but the idea is by no means as far fetched as it may sound, for we already have artificial organs which can take over the function of one part of the brain, the respiratory center. Can we someday, when we understand the brain better, achieve what would amount to artificial metempsychosis -- a transfer of human personality from a natural to an artificial brain?

"Fantastic? Perhaps, but imagination is the heart of simulation."

At the same session, A. Ben Clymer, senior technical specialist, North American Aviation Inc., Columbus, Ohio, described simulation of human operators on a computer. Taking into account the small idiosyncracies that humans may have, the simulations were of such quality "as to have deceived pilots into believing for periods from 30 seconds to several minutes...that they were in control of a laboratory tracking device, whereas in fact the task had been taken over by an electronic analog pilot simulator unbeknownst to them."

ASSOCIATION FOR COMPUTING MACHINERY -- ELECTIONS

The members of the Association for Computing Machinery have elected Dr. Harry D. Huskey of Berkeley, California as the new president. Dr. Huskey is Professor of Electrical Engineering and Mathematics at the University of California in Berkeley. Dr. Jack Moshman, Director of Mathematical and Statistical Services, C-E-I-R Inc., Arlington, Virginia has been elected Vice-President, and Dr. Bruce Gilchrist, Manager, IBM Research Computer Center, Yorktown Heights, New York is the new Secretary. The officers will serve for a term of two years.

The Association for Computing Machinery, founded in 1947, now has more than 6,000 members in the United States and abroad.

UNIVERSITY COMPUTER CENTER FOR EDUCATION AND RESEARCH

Univ. of Southern California, University Park, Los Angeles 7, Calif.

Establishment of a $2-million University of Southern California Computer Center for Education and Research was announced in May by Dr. Norman Topping, USC President.

Two of the nation's leading designers and manufacturers of electronic, all-transistorized data processing equipment -- Remington Rand and Minneapolis-Honeywell -- will install their newest, most modern high-speed computers on the USC campus.

A Univac Solid State 80 with magnetic tape units will be placed in the USC Computer Center by Remington Rand this fall. Also, a complete line of 90 column punched card equipment, including a Univac 120 electronic computer and a model 330 electronic punch card calculator has been installed.

A Honeywell 800 electronic data processing system including a central processor, tape control, magnetic tape transports, printer/card-reader/card-punch control, high speed printer, card reader, and card punch will be installed in June, 1961.

"Formation of this outstanding Computer Center at a private university with the complete cooperation of two private business firms marks a new milestone in joint enterprises between industry and education," President Topping said.

The USC Computer Center is believed to be the only one of its kind in the United States because of the installation of equipment by two computer companies in the same building on a university campus.

Both companies, which are expanding rapidly in the 13 western states, will train employees at the Computer Center, house their students in campus dormitories, and have them eat in the University Commons.

Remington Rand started its first class April 4, and it has already been graduated. Other classes are in session, and more will follow at regular intervals.

Walter W. Finke, Honeywell vice-president and president of its Datamatic division, said his company expects to establish its advanced training program at the University later this year.

Congratulating USC on its forward thinking in establishing its computer center, Finke emphasized the important role of electronic data processing in present-day business management.

"The management man who claims a well-rounded understanding of today's business operations must have a basic working knowledge of electronic data processing in its many commercial and industrial applications," he said.

"Any business curriculum at the college or university level is incomplete without training in the part that electronic data processing plays in the business world. In fact, this training should be a pre-requisite to all advanced management degrees."

T. J. Norton, Remington Rand vice-president, said that the installation of a Univac Solid-State computer at the University was part of a long-range program on the part of Remington Rand to establish similar centers throughout the country. He praised the University for its foresight in expanding its educational facilities to include computers and assured USC that the latest in equipment and research would be made available to University personnel.

USC professors and graduate students in business, engineering, medicine, and the physical and social sciences will be given one eight-hour shift a day, Mondays through Fridays, on both computers to conduct their scientific research projects.

In addition, the Computer Center will permit USC to expand its existing classes in the use of computers and establish new ones.

Each company will cooperate with the University in new research projects in the rapidly-expanding field of computer science, seeking new uses for computers and working on designs to improve existing equipment.

Company teachers will be available to lecture to USC students, and University faculty members will likewise be able to meet with company classes.

A library of computer knowledge will be established on the campus for the use of both company and University students and faculty members.

MAGNETIC LEDGER CARDS AND OTHER CAPACITIES OF THE NCR 390

National Cash Register Co., Dayton 9, Ohio

The NCR Type 390 is a solid-state, magnetic-core, fully transistorized, economical data processor that may be used to handle all basic accounting functions. It consists of: a central processor; a console; input units; and auxiliary equipment to create punched paper tape, punched cards, ledger cards, and control other peripheral equipment. The 390 is fully compatible with other data processing machines, and so it may be integrated into all existing data processing systems.

Two features of the 390 are remarkable in a low-cost data processing system for general business use: (1) a novel magnetic ledger card that stores data in magnetic tape strips on the back of the form, yet carries all necessary printed information for reference and auditing on the front of the form; (2) a programmable printer able to print final results in any desired columnar arrangement on multiple forms and reports.

In general, all commercial data processing systems have the same basic requirements: the system must have the ability to perform arithmetical calculations; the ability to classify, summarize and distribute transactions and entries; the ability to print and maintain accounting records and files for reference purposes; the ability to create payroll, billing and other documents; and the ability to organize all of this information into statistics and reports for management. The 390 can perform all of these operations.

The 390 System has four kinds of input:

1. Input from punched paper tape;
2. Input from data stored on the magnetic ledger cards;
3. Input from punched cards;
4. Input by operator entry on the console keyboard.

All four of these methods may be used simultaneously.

The 390 also has four methods of output:

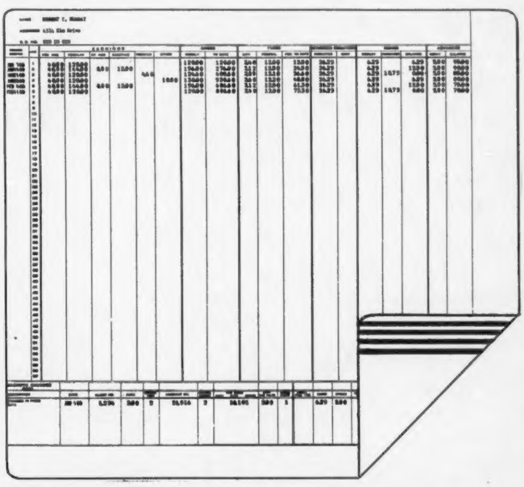
1. Print-out on reports or multiple-copy hard-copy records;
2. Output to punched paper tape;
3. Output to punched cards;
4. Output to magnetically-encoded ledger cards.

Three of these output methods may be used simultaneously; the only limitation is that cards and tape may not be used at the same time.

The printer of the 390 system does in one operation what would require three or four separate runs on other processors. The printer and its continuous-form feeding device may be programmed to print in any columnar arrangement on multiple-copy forms, on related accounting forms, and on reports. For example, in a payroll application, five fundamental records are needed: checks; pay statements; earnings records; a payroll journal; and a check register. By processing these related records in one simultaneous operation, the 390 assures that all records and processed data are identical. When one set of records is in balance, all records are in balance.

The magnetic ledger card is a noteworthy feature of the 390 System. This card combines human language and machine language on the same record. Records of totals, balances, rates and other figures about the account are printed in ordinary characters on the front of the ledger card; the same information is stored in polarized spots on strips of magnetic tape on the back of the form. The magnetic ledger card thus combines the advantages of detailed historical ledger records, and the speed, flexibility and storage capacity of magnetic tapes.

The magnetic strips on the ledger card resemble a section of tape in a reel of magnetic tape in a larger computer. In essence the reel of tape has been reduced to strips, and the strips are then fastened on the back of the ledger card. The magnetic ledger card thus creates a new device in data processing, one which does not force the user to sacrifice fundamental written records of customary accounting.



A magnetic reading device is built into the printer. In less than two seconds the reading device automatically aligns the magnetic ledger to the proper posting position, reads and verifies about 200 characters of encoded information, and electronically verifies that the correct ledger is in the printer.

The file of ledger cards is easily expandable, or ledger cards are as easily removed. Specific accounts may be interrogated without interrupting the monitor or the operation of the processor. The ledger cards are always available for random-access posting or for random-access inquiry. By furnishing a printed historical record, the magnetic ledger cards perform an important function not available before in a low-cost system.

Each time an account is processed, the totals and balances affected are updated in both human language and encoded machine language. The electronic encoding on a particular ledger card may actually interrogate the central processor and modify the program according to the requirements of the specific account.

THE TELEMETRY AND DATA ANTENNA AND THE COMPUTER TO POSITION IT

Philco Corp., Western Development Laboratories, Palo Alto, Calif.

The Telemetry and Data Antenna at Palo Alto is a three-axis antenna, built on order for the Air Force, for use in communication systems for space explorations. Known as "the dish", it is a 15-ton saucer manufactured to a mechanical precision of 65-thousandths of an inch. The "dish" normally operates atop an 80-foot pedestal; the whole assembly weighs more than 150 tons. A Philco 2000 Computer at Western Development Laboratories controls the huge antenna in real-time.

In tracking an earth satellite, a real-time control program uses the results of a computer program that predicts the orbit to calculate where the antenna must point to track the satellite. It also keeps the antenna trained on the satellite throughout its passage over the tracking station. This requires "punctuality measured in milliseconds"; and the computations require the computer to operate in terms of microseconds.

Among other applications of the computer, when it is not busy with the "dish", are: determination of optimum tracking equipment configurations and accuracy requirements; simulation of orbits for scheduling purposes; and, evaluation of the performance of existing tracking equipment.

SIX OPTICAL SCANNERS FOR STANDARD OIL CO. AND TIME, INC.

Farrington Mfg. Co., Needham Heights 94, Mass.

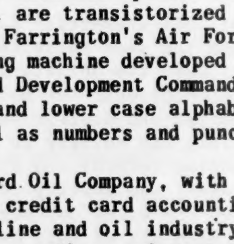
Six electronic character-reading machines have been ordered by two major Chicago firms to help handle their paperwork problems -- Standard Oil Company, three, and Time Inc., three.

Time Inc. will use two advanced models of the machines to read the names and addresses of new subscribers and automatically convert what has been read into machine language on magnetic tape for further data processing. A third optical scanner will be used to read postal card returns to Time Inc., extracting account numbers and sales information.

The two advanced optical scanners ordered by Time Inc. are transistorized commercial versions of Farrington's Air Force Page Reader, a reading machine developed for the Air Research and Development Command which will read upper and lower case alphabetic characters as well as numbers and punctuation.

Standard Oil Company, with the largest centralized credit card accounting operation in the gasoline and oil industry, will use Farrington's reading equipment to provide faster, economical and more accurate charge card billing.

The optical scanners will read the account numbers on customer invoices much faster than the human eye and record what has been read into punched cards for further automatic data processing. Heretofore, it has been necessary to convert the invoices manually.



PUNCHED TAPE AS A BYPRODUCT OF ADDING

Victor Adding Machine Co., 3900 No. Rockwell St., Chicago 18, Ill.

Punched tape for data processing as a by-product of routine adding machine computations is a result of a data punch developed by this company.

The unit consists of a 10-key adding machine associated with a tape punch. The punch produces 5,6,7, or 8 channel punched tape at a rate of 20 characters per second. A variable field-control selector permits fully optional control over the columns to be punched. The function selector control allows the operator to punch items only, totals only, or both items and totals. The tape punch may also be turned off completely and the unit operated like an ordinary adding machine. The adding machine during all operations produces a printed detail tape for immediate use.

100TH UNIVAC SOLID STATE COMPUTER

Remington Rand, Division of Sperry Rand, 315 Park Ave. South, New York 10, N.Y.

The one hundredth Univac Solid-State computer was shipped on May 20. It was manufactured at the Remington Rand Univac Division at Ilion, N.Y.

Building the Univac Solid-State computers at Ilion began in January, 1959, after some 10 for European delivery were produced at the Remington Rand North Philadelphia plant, where they were initially designed and developed.

These computers were the first solid-state computers to be made available anywhere. They are now being produced on a schedule of one a day. They have been delivered to a great many types of businesses and governmental agencies in the United States and abroad.

JOINT AUTOMATIC CONTROL CONFERENCE, CAMBRIDGE, MASS., SEPT. 7-9, 1960

Wm. D. Archibald, Energy Control Co., 5 Beekman St., New York 38, N.Y.

The first annual Joint Automatic Control Conference will take place on Sept. 7, 8, and 9 on the campus of the Massachusetts Institute of Technology. The main theme is "Frontiers of Control". The objective of the JACC is to establish a single high-level technical conference devoted exclusively to the theory and application of automatic control techniques and equipment. This unique venture recognizes the growing stature and importance of the field of instrumentation and control within the broader interests of the five co-operating societies. The JACC sponsors are the American Society of Mechanical Engineers, the American Institute of Chemical Engineers, the American Institute of Electrical Engineers, the Institute of Radio Engineers, and the Instrument Society of America. ASME is the host society for 1960.

The program will total 18 technical sessions, with three sessions going on simultaneously during the six morning and afternoon periods. The program committee will integrate papers and schedule their presentation according to subjects of prime interest to conference attendees. Among the 18 sessions will be three sessions on sampled data and adaptive control, three on process dynamics, four on computer control, and three on control components. A special feature will be a first-hand report on the proceedings of the first International Congress of the International Federation of Automatic Control to be held in Moscow, USSR., this June. This report will be given on the Thursday evening of the JACC conference.

For further information and for a copy of the advance program to be ready this summer, write to the JACC General Chairman, Wm. D. Archibald, Energy Control Co., 5 Beekman St., New York 38, N.Y.

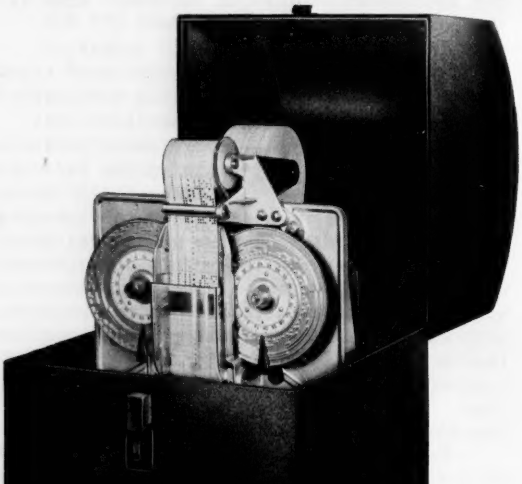
A TRAFFIC RECORDER OR GENERAL DATA TRANSLATOR

Fischer & Porter Co., 552 Jacksonville Road, Warminster, Pa.

An automatic traffic recorder that produces a punched-tape record especially designed for translation into punched-card form is in production at this company.

The new recorder "Traffic Operation Punch" maintains a running total of motor vehicle traffic and records the total on a binary coded paper tape every 15, 30, or 60 minutes. The tape can be converted into punched cards, punched computer tape, or typewritten form, completely eliminating manual data handling. For instance, a month's readings recorded at 15-minute intervals can be translated into punched cards in about 15 minutes. The translator also allows the program to be varied to meet the requirements of different computers. Because data translation is automatic, many more points can be surveyed with no additional personnel.

The recorder accepts signals from any type of detecting element, such as a treadle, pneumatic tube, radar, electric eye, or sonic detector.



The operation of the traffic recorder is simple. Signals from a sensing element operate electrical contacts that drive a pulse motor, which in turn is geared to two coded discs. The discs, through a code represented by raised portions on their surfaces, translate the rotational information into punched information on the paper tape. The pulse motor and the two coded discs on the front of the unit are geared in such a fashion that 1000 cars will produce one revolution of the right hand wheel. The gearing arrangement between the right and left hand wheels is 100 to 1.

The raised sections on the discs translate the rotational information into punched information on the tape. A raised section on the disc allows a hole to be punched -- a valley does not.

A clock-driven cam initiates a punching every 15, 30, or 60 minutes. The position of the wheels at the time of the punching is proportional to the total number of cars counted.

The traffic counter is not only available as a permanent model but also as one powered by a six-volt dry cell battery, resulting in a total weight of only 40 pounds. Because ball bearings are used throughout, the drain on the battery is slight -- the battery will last one year at 15-minute readout intervals. A year's supply of tape can be held.

The permanent unit is mounted on a sliding mechanism that allows the unit to be installed in a standard type of traffic enclosure. The slide allows the unit to be swung clear of the box to provide complete accessability. The permanent unit contains its own rectifier and will operate on standard 110-volt power.

Although the recorder is designed for traffic surveys, it can record signals from any two wire contacts. The unit is capable of recording 30 counts per second.

LIGHT-WEIGHT TELEPRINTER

International Telephone and Telegraph Corp., 67 Broad St., New York 4, N.Y.

Among engineering and scientific highlights in the English Government's own exhibit at the British Exhibition June 9 at the New York Coliseum is a new Creed & Company lightweight 100-word-per-minute teleprinter.

Creed, an associate of ITT, has installed these teleprinters aboard British Overseas Airways north Atlantic flights; they are used to receive ready-to-read weather information transmitted from both shores of the ocean.

Resembling an ordinary typewriter, the teleprinter weighs only 35 pounds. A stationary paper carriage and moving typehead play a big part in reducing the weight.

The equipment can be designed as a receiver only or a combined transmitter-receiver with 3 or 4 rows of power-assisted keys. It can send and receive signals of the parallel-wire type commonly used by electronic computers, and it can be modified to perform a variety of special functions either internal or external to itself.

The machine may also contain a punched tape reperforator, enabling incoming and outgoing messages to be coded automatically.

INTERNATIONAL SYMPOSIUM ON DATA TRANSMISSION, DELFT, NETHERLANDS, SEPTEMBER 19 to 21, 1960

Interested persons are cordially invited to this Symposium, which will be conducted in English and is open to all interested professional people. It will be held at the Technische Hogeschool and is sponsored by The Benelux Section of the IRE in cooperation with Het Nederlands Radiogenootschap, The IRE Professional Group on Communications Systems, and the Sectie voor Telecommunicatietechniek of the Koninklijk Instituut van Ingenieurs.

The Symposium will give engineers a unique opportunity to discuss the problems of data transmission with experts from both sides of the Atlantic.

The field to be covered includes the following topics:

- Choice of modulation
- Detection of telegraph signals
- Error rates over land lines and radio links
- Computers for data transmission networks
- Communication feedback techniques
- Evaluation of error detection and correction procedures

The still incomplete list of authors includes representatives of the following organizations:

- Bell Telephone Laboratories, USA
- Georgia Institute of Technology, USA
- International Business Machines, Corp., USA
- Cie. IBM France
- Marconi's Wireless Telegraph Co., UK
- Ministry of Aviation, UK
- Post, Telegraph, and Telephone Service, Netherlands
- New York University, USA
- SHAPE Air Defense Technical Center, Netherlands
- MIT Lincoln Laboratory, USA

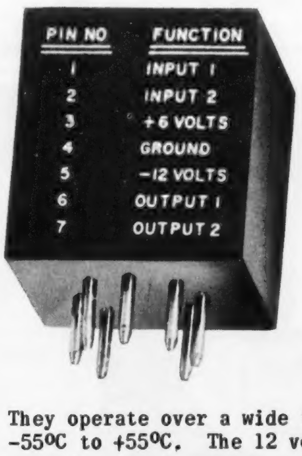
Delft is situated about 10 km from Den Haag (The Hague) and the seaside resort of Scheveningen. Thus people attending the Symposium will normally have hotel reservations at either of these two towns. A coach service will be arranged to carry participants between their hotels and Delft.

VISAS. The Netherlands Ministry of Justice has promised its cooperation to the Symposium Committee in the matter of issuing entrance visas. (This applies mainly to countries in Asia and Eastern Europe.) Registrants who will require entrance visas are requested to inform the Committee as soon as possible.

For further information about the Symposium, write to the Secretary: B. B. Barrow, The Benelux Section, IRE, Postbus 174, Den Haag, Nederland.

FLIP FLOPS, 1960 STYLE

Cambridge Thermionic Corp., 445 Concord Ave., Cambridge, Mass.



New, high-speed, extremely rugged flip-flops (bistable multivibrators) designed for electronic data processing systems, have been developed by this company.

These flip-flops, only 0.35 cubic inches in size, have a superior frequency response (DC to 10 MC). They weigh only 9 grams. They operate over a wide temperature range, -55°C to +55°C. The 12 volt logic provides a superior level output capable of driving many related circuits. The standard 7-pin base design permits easy insertion into sockets for development work, dip-soldering in printed circuit boards and rapid assembly into finished computers.

Extensively tested, these flip-flops are suitable for wide applications in digital equipment.

NEW AIR-SPACE NAVIGATION SYSTEM

International Business Machines Corp., Federal Systems Div. Lab., Owego, N.Y.

A computer-directed optical map projection system under development here by engineers of this company may enable the pilot of a supersonic plane to tell his location over the earth by merely glancing at a screen on his instrument panel.

The experimental system can project a highly accurate circular map of an area 400 miles in diameter (125,000 square miles) on a 7½ inch screen. An airborne computer performs all the calculations necessary to position the map on the screen and pinpoint the pilot's location in relation to the ground. He can literally see on the display map what city, town, or area he is flying over.

The heart of the navigation display is a glass hemisphere about 6 inches in diameter. A detailed map of half the earth is reproduced photographically on its inside surface. A beam of light illuminates a small section of the map, which is then projected onto a flat, translucent screen in front of the pilot. As the plane moves, the computer automatically adjusts the map presentation.

A similar display device could be used in space navigation. To use the system in space, a technique known as stellar map matching might be employed. A stellar map, or "chart of the heavens," would replace the map of the earth inside the glass hemisphere and be projected on the screen. Then a telescope view taken in a known direction relative to the space craft would also be projected on the screen, superimposed on the space map projection. When the stellar map and the telescope view are lined up, the computer can automatically determine the position of the space craft.

COMPUTER CENSUS AS OF JANUARY 1960

(Prepared by and reprinted with permission from Automatic Data Processing Newsletter, Jan. 11, 1960, published by John Diebold and Associates, 40 Wall St., New York 5, N.Y.)

Large-Scale General Purpose Digital Computer Systems

Manufacturer	*Computer*	*Delivered*	*On Order*††
Burroughs	Burroughs 220	31	75*
Control Data Corp.	1604***	0	—
Minneapolis-Honeywell	Datamatic 1000	7	—
	Honeywell 800	0	30*
IBM	701**	9*	0
	702**	11*	0
	704	120*	—
	705	165*	—
	709	50*	—
	7070	0	100*
	7090	2	12*
National Cash Register Co.	304	3	14
Philco	Transac S-2000	3	15
RCA	Bizmac I**	1	0
	Bizmac II**	4	0
	501	10	35
Remington Rand	Univac Scientific, 1100 Series	45	3
	Univac I** & II	80	5

Total Large Scale Computers 541†

* Unofficial estimate.
** No longer in production.
*** Recently announced — no on-order figures available.
† 71% incr. over 1/12/59.
†† See Note, bottom of tables.

Medium Scale General Purpose Digital Computer Systems

Manufacturer	*Computer*	*Delivered*	*On Order*††
Alwac	Alwac III-E w/tapes	4	—
Bendix	G-15 w/tapes	119	—
Burroughs	205 w/tapes	94	30*
IBM	650 w/tapes and/or Ramac	265*	—
Remington Rand	Univac File-Computer O & I	108	15
	Univac Solid-State 80 & 90	51	205
Underwood	Elecom Series**	13	0

Total Medium Scale Computers 654†

* Unofficial estimate.
** No longer in production.
† 88% incr. over 1/12/59.
†† See Note, bottom of tables.

Small Scale General Purpose Digital Computer Systems

Manufacturer	*Computer*	*Delivered*	*On Order*††
Alwac	Alwac II & III**	8	0
	Alwac III-E	30	8*
Autonetics	Recomp II	24	24
Bendix	G-15	161	—
Burroughs	205 (no tapes)	26	12*
IBM	650 (card)	1,200*	—
	305 Ramac	575*	—
	1620	0	15*
	1401	0	750*
Monroe Calculating Machine Co.	Monrobot VI**	9	0
National Cash Register Co.	102**	30	0
J. B. Rea	Readix**	4*	0
Royal McBee	LGP-30	350	16
	RPC-4000***	0	—

Total Small Scale Computers 2,417†

* Unofficial estimate.
** No longer in production.
*** Recently announced — no on-order data available.
† 76% incr. over 1/12/59.
†† See Note, bottom of tables.

Miscellaneous Digital Computers

Manufacturer	*Computer*	*Delivered*	*On Order*††
Burroughs	E101	205	20*
IBM	604	4,500*	—
	607	535*	—
	610	40*	—
	CPC**	60*	—
Monroe Calculating Machine Co.	Monrobot IX	38	47
Remington Rand	Univac 60 & 120	900	95
Underwood	100**	18	

Total Miscellaneous Computers 6,296†

* Unofficial estimate.
** No longer in production.
† 22% incr. over 1/12/59.

†† NOTE: Re *On-Order,* an entry without asterisk means that the figure has been verified; a figure with an asterisk means that the figure, while unofficial, has some substantiating basis; a dash (—) indicates that no meaningful information is available.

NOTES: As in the last census, the figures here are on a *systems* classification, based on the computer and its associated peripheral equipment as defined below. There is no implied evaluation of machine capabilities in terms of large, medium, and small. Minimum requirements for each class follow:

Large-scale: The system uses magnetic tapes and the computer operates at microsecond arithmetic speeds. Price in general is in the order of magnitude of one million dollars or more. *Medium-scale:* The system uses magnetic tapes and the computer operates at millisecond arithmetic speeds. In general, the price range is from $500,000 to $1,000,000. *Small-scale:* The system does not use magnetic tapes but the computer is internally programmed. *Miscellaneous computers* are card calculators and other machines which do not fall into one of the above systems classifications.

Significant individual increases over year-ago installed figures are the large-scale IBM 709 and the Univac Solid-States. The figures reported in this census are exclusive of reported foreign business — 24 installed and 51 on order.

Newcomers added to the census listing this year are the large-scale Control Data Corp. 1604, and in the small-scale category, IBM's 1620 and 1401, and Royal McBee's RPC-4000. In this category, the Autonetics Recomp II was inadvertently omitted in the last census.

The Burroughs figures do not reveal the intense activity in the computer system introduced in 1959 for banks — the Visible Record System, "VRC." Burroughs reports, as of the end of 1959, 41 systems on order.

Apparently now definitely withdrawing from the computer field are Alwac Division of El-Tronics, Inc., and Underwood. The latter has withdrawn the "on-order" figures submitted in the previous census, and advises that it is de-emphasizing activity in this field, although the 18 listed as delivered are in active service.

The Probable Effects of Automatic Computers on the Professions

Patrick J. McGovern

Mass. Inst. of Technology
Cambridge, Mass.

What role will the automatic computing machine have in the life of the professional man? Where can it presently play an important part — and, more importantly, where will it be used in the future to handle part or all of the responsibilities of the professional man?

The answers to these questions will not only have a vigorous effect on the status of professionals in America, but the answers will also indicate several significant means by which automatic computing machines will shape the American economy.

Economic Strength of Professions

Here are the facts: Government statistics show that 8.8% of the American working force is classified in the professional fields. (See Table 1). However, this same group accounts for almost 15% of the total national income.

The geographical concentration of this financial might is also impressive. Reliable surveys estimate that seventy to seventy-five percent of the professional workers live and work in urban communities of over 50,000 population. The professional workers are clearly a powerful component of the American economy, and prospectively, the work they do stands as a big market for the makers of automatic computing machines.

Who Are the Professional Workers?

Now just who are these professional workers, and what positions do they occupy? To answer this, Table 1 has been constructed to show the subdivisions of the professional field that account for at least one percent (49,000) of the total professional class. The table indicates the number of people in each subdivision, and their percentage of the total. A look at the table will give the reader an idea of the range and diversity of positions held by the professional worker.

Mechanical vs. Personal Service

It is obvious that present forms of automatic computing machines can only partially replace the human being in many of these positions. Nor can the machine, in most cases, perform even a majority of the duties performed by the professional man. However, in almost every professional field, there are some phases of professional activities which automatic computing machinery can handle more efficiently and more economically than a human being.

To show this more clearly, let us make a rough division of the work of each of the job classifications listed in Table 1. The work for each can be classified into two groups: "mechanical service" and "personal service." The term mechanical service indicates that part of a professional man's duties that might be taken over effectively by a computer or some related form of automatic machinery. The term personal service refers to those of his duties which no machine can as yet attempt, for example, duties requiring understanding of spoken language, sympathetic attention to human emotions, judgment of psychological effects, etc.

Suppose we classify the professions in classes from A to E in accordance with the relative proportion of mechanical service which they provide. This classification should indicate the relative productivity of each of the classes in regard to prospective labor-saving computer sales. Attempts will also be made to indicate the size and type of the computer of greatest usefulness, and the number of such computers that might be employed.

It is important to note that not all of the computers indicated for use on professional problems need be owned by professional men. Most likely the greater number will be in joint ownership by groups of professional workers, or used on a rental basis from industry-owned service groups.

Although many of these figures are necessarily rough estimates, the organization and the overall range of the professional field which they reveal should provide a reasonable foundation for planning increased application of automatic computing machines in the professional fields.

Best Bet For Computer Use

CLASS A: Good field for the use of computing machinery, medium to large size ($50,000 up):

Accountants and auditors

This class provides 7.8% of the professional field. At an average salary of $5500 annually, they represent a total annual income of $2,070,000,000. If about forty percent of their duties were performed on a computer, the saving in labor costs alone would be nearly $830,000,000. If one medium-sized computer can be said to replace eight men on the average, the number of computers that are needed to effect this change is 18,800.

Small Computers Useful

CLASS B: Good field for computer use, but probably only small-size computers needed (below $50,000):

Draftsmen
Civil Engineers
Electrical Engineers

This class represents about 7% of the professional field. At an average salary of $5500 annually, their yearly total income amounts to $1,880,000,000. If about twenty percent of their duties were performed by a computer, this would mean an annual saving in labor costs of $376,000,000. And if one small-sized computer can, on the average, be said to replace four men, the number of computers needed

Table 1

OCCUPATIONS AND EMPLOYMENT IN THE PROFESSIONAL FIELD

Title	Number of People	Percent of Total	Classification
TOTAL	4,900,000	100.0%	
Accountants and auditors	376,000	7.8%	A
Artists and art teachers	77,000	1.6%	E
Chemists	74,000	1.5%	C
Clergymen	166,000	3.4%	E
College professors and instructors	125,000	2.6%	E
Dentists	75,000	1.5%	E
Designers	49,000	1.0%	C
Draftsmen	120,000	2.4%	B
Editors and reporters	78,000	1.6%	E
Engineers, chemical	50,000	1.0%	C
Engineers, civil	122,000	2.4%	B
Engineers, electrical	107,000	2.2%	B
Engineers, industrial	49,000	1.0%	C
Engineers, mechanical	110,000	2.2%	C
Judges and lawyers	180,000	3.7%	C
Musicians and music teachers	152,000	3.1%	E
Natural scientists and naturalists	50,000	1.0%	C
Nurses, professional and student	465,000	9.5%	E
Personnel and labor relations workers	49,000	1.0%	E
Pharmacists	88,000	1.8%	E
Photographers	50,000	1.0%	E
Physicians and surgeons	189,000	3.9%	E
Religious workers	50,000	1.0%	E
Social and welfare workers	75,000	1.5%	E
Sports instructors and officials	49,000	1.0%	E
Teachers, elementary and secondary	1,125,000	23.0%	D
Technicians, medical and dental	76,000	1.5%	C
Technicians, testing	75,000	1.5%	C
ABOVE GROUPS	4,250,000	86.7%	
ALL OTHER GROUPS	650,000	13.3%	

(These statistics and the others used in this article are taken from: "Section 8: Labor Force, Employment, and Earnings," Statistical Abstract of the United States, U.S. Department of Commerce, published by the Government Printing Office, 1956, pp. 191-235.)

to provide for this output is 17,200. Note: Putting electrical engineers in Class B, instead of putting them into Class C, is warranted by the increasing number of small independent engineering groups who do consulting and experimental work on computers, their circuitry, their components, and their applications.

Organizational Use

CLASS C: Some use for computers of various sizes, but only in large organizations with many workers:

Chemists	Judges and lawyers
Chemical engineers	Medical and dental technicians
Industrial engineers	Testing technicians
Natural scientists	Designers
Mechanical engineers	

This class represents about 14.4% of the professional field. However, only about ten percent of them work in organizations large enough to profitably use a computer. And at that, a computer would probably be able to do the work of only about ten percent of that group. This means that only about one percent of the work would be performed by a computer. At that, since this group has an annual income of about $6000, this would mean a total annual saving in labor costs of $34,000,000. And if we say

that one computer can, on the average, replace six people, this calls for about 1,250 computing machines.

Note: Judges and lawyers have a rightful place in this class, it seems to me, since a large portion of their work is concerned with information handling, a job well suited for the computer.

The inclusion of technicians here is also plausible because of the increased use of automatic testing and analytic equipment in their field. The computer has a positive role to play in the piloting and control of this equipment, as well as in the statistical handling of the results.

Information Machines For Teachers

CLASS D: This is a special group having increasing need for specialized types of information-handling machines — mostly small-sized:

Teachers, elementary and secondary

This group represents 23.0% of the professional field. At an average annual salary of $4500, their yearly total income amounts to $5,105,000,000. However, their work is of such a nature that the computing and information-handling machines applicable would tend to supplement rather than replace the worker. Already automatic grading systems by machine processes are in operation. The increased use of teaching machines, automatic visual and auditory teaching systems, etc., is likely, up to the limit of public support of education. Therefore, if people can be expected to spend just one-tenth of what is spent for teachers' salaries for educational information-handling machines, there will be a $510,500,000 annual market established for automatic machines usable in educational processes.

The Computer's Most Reluctant Field

CLASS E: Probably having little use for computers in the foreseeable future because of individual or qualitative type of work:

- Artists and art teachers
- Clergymen
- College professors and instructors
- Dentists
- Editors and reporters
- Musicians and music teachers
- Nurses, professional and student
- Personnel and labor relations workers
- Pharmacists
- Photographers
- Physicians and surgeons
- Religious workers
- Social and welfare workers
- Sports instructors and officials

This group represents 33.8% of the professional field. At an annual income of $5000, they have a total annual salary of $8,300,000,000. However, computing machinery constructed to date has not been able to duplicate any significant portion of the responsibilities of these positions. This in no way means that in the future, more adaptable and more versatile machines will not be made to perform these duties. This group of professional positions represents a major section of the American economy for computing machine builders to finance serious and determined efforts at building the types of automatic computing equipment needed.

The remaining fraction in this analysis (13.3%) includes scattered professional and semi-professional people in groups too small to classify. As might be expected, they mainly use personal contact and familiarity with specific circumstances in the course of their work. Computers might not be expected to duplicate more than 0.5% of their duties. Even this, at an average salary of $5500, would amount to $18,000,000 a year. Or if we might speculate that one computer could replace four people, this is a market for approximately 810 new machines.

The classification of the various occupations into classes has, of course, been somewhat arbitrary; reasonable objections might be raised here and there. But recognizing these classes helps illuminate the potentialities of the market for ownership and rental of computers in the professions. Individual categories may well vary, but the overall estimate of computer applications should remain valid to some degree. The economic figures drawn from this analysis serve to point out sharply the size and the importance of the segment that the professions add to the market for computing machinery.

Computer People Build Their Own Future

How much of this potential field will be developed by computing manufacturers? This depends on two factors: (1) social resistance to employing computers in the place of human beings, and (2) the skill and ingenuity of the designers of computing machinery in making their products economically desirable and useful to the professional man. The first factor, elimination of social resistance, is a matter that time and education are producing. The second factor is the crux of new future successful applications of computing machinery. It is certain that the computer field is one of tremendous economic and physical growth. However, it remains to the talents of the designers, engineers, and scientists of the computer industry to determine the success in other *professional* fields and in the market generally.

Readers' and Editor's Forum

FRONT COVER: INTEGRATED AUTOMATIC TOLL COLLECTING

The newly expanded, six-lane, Vancouver-Portland Interstate Bridge enables 36,000 vehicles per day to cross the Columbia River on U.S. Highway 99 between Washington and Oregon. A toll plaza with fourteen lanes makes use of an up-to-date vehicle classification system and automatic toll collection system. The system was designed and built by Taller Cooper Division of American Electronics, Inc., Brooklyn, N.Y. The system also provides for control of revenues, handling credit card customers, furnishing receipts on request, and producing a printed record and a punched tape of transactions.

Of the fourteen lanes in the toll plaza, eight are automatic "exact change" lanes equipped with automatic toll collection machinery. Here, a toss of the correct amount of coins or specially designed tokens into the hopper automatically gives the driver the green light to proceed.

The other six lanes are manned. Anything from a motorcycle to a trailer truck is classified and keyed for the appropriate toll on classification button-box equipment. Working in conjunction with the vehicle classification equipment are receipt printers and automatic charge devices.

In handling "charge accounts," the toll collector enters the vehicle classification from the button box keys, and the driver hands the toll collector his perforated charge-plate. The charge machine automatically transmits the driver's account number (punched in the charge plate) and transmits the vehicle classification to the punched tape recorder, and the printed recorder. When the charge plate is withdrawn, the light turns green and the vehicle proceeds.

COMPUTERS AND DATA PROCESSING IN BUSINESS EDUCATION

I. From Enoch J. Haga

272 Plum St.
Vacaville, Calif.

To the Editor:

As you will see from the following announcement, Dr. Dana Gibson of San Diego State College and I are trying to do something to counteract the extremely negative and hostile business education press when it comes to automation.

You may not realize that some business educators have taken a dim view of those seeking to alert teachers to signs of the changing times.

Some of these business educators have taken the view that increased emphasis on science and math and fundamentals is *ruining* business education. We take the opposite view and believe that science and math and business can find a common meeting ground. We find no substitute for fundamental education.

We hope that you will print our announcement and we will welcome anyone sympathetic to our cause. We think that perhaps we will be able, once in operation, to cooperate with the Working Group for Better Education which Computers and Automation is promoting.

OUR SOCIETY CAN SERVE A USEFUL FUNCTION BY CREATING AND FOSTERING UNDERSTANDING OF COMPUTERS AND AUTOMATION AMONG BUSINESS EDUCATORS. Believe me, to date they have exhibited plenty of ignorance and misunderstanding.

II. Announcement of the Society for Automation in Business Education (SABE):

A **Society for Automation in Business Education** is being formed. The purpose of this nationwide organization is to promote the growth and development of knowledge and understanding of automation among business teachers and other interested persons. Toward that end the Society plans to unite these persons into a cohesive group, provide them with a forum for the interchange of fact and opinion concerning automation, and supply business magazines with factual data of interest to their readers, with the hope that biased opinions will be reduced in number and answered where necessary.

Persons interested in automation and business education are cordially invited to write for further information. All interested business teachers, educators, businessmen, and others may be considered for membership in the Society. Write to Dr. E. Dana Gibson, Professor of Office Management, San Diego State College, San Diego 15, California, or to Enoch J. Haga, 272 Plum Street, Vacaville, California.

A MIDGET COMPUTER

L. Agayan
Moscow, U.S.S.R.

An electronic computer of novel type has been developed by a group of young engineers, graduates of Moscow University and the Moscow Power Engineering Institute. They have given it the name of the river Setun flowing near the University on the Lenin Hills.

Recent years have seen quite a number of computer designs appear in the Soviet Union. The Setun, however, differs markedly from them all. For one thing, it has been conceived as a midget computing facility suitable for use in colleges, research laboratories, and design offices. And it is small, taking up not more than 20 square meters of floor space. On top of it, the computer is reliable in service, simple to operate, and cheap to produce.

The construction of the Setun embodies many novel features. Among them is a ternary notation. Electronic computers usually operate on a binary system where only two digits — 1 and 0 — are utilized. The code used in the Setun is still more economical, since it makes use of three digits: +1, 0, and −1. They are expressed by positive and negative pulses. A positive pulse designates +1, a negative pulse stands for −1, while no pulse will denote zero. The ternary code has doubled the computer's speed and cut by half the number of components.

Another feature of the Setun is a two-step input data and program storage. The main memory is a magnetic drum on which input data are recorded much in the same way as in a tape recorder. The other memory is small (162 words), with an extremely short access time.

The two-step storage operates like this: The magnetic drum feeds data and instructions into the secondary memory which transfers them to high-speed arithmetic units. The first batch of information being processed, the magnetic drum feeds a second, then a third, etc., batch of information. Thus, a compromise has been reached between low cost and high computational speed. Incidentally, the Setun draws one-third of the power taken by the Ural-1 belonging to the same class, while performing 4,000 operations every second for each 100 operations made by the Ural-1 in the meantime.

A third feature of the Setun is that it uses quick-action magnetic amplifiers instead of valves. Their number in the computer runs into about 4,000. The magnetic amplifiers are advantageous in that they are cheap to manufacture, compact, draw little power and have a much longer life than valves. True, the Setun has valves, too, but there are a mere 40 of them.

The Setun started operating recently. But the records can already give an idea of its potentialities. It has solved a problem involving the electronic density in crystals for the Institute of Crystallography (the USSR Academy of Sciences). It has also solved a problem for the Joint Nuclear Research Institute at Dubna, related to nuclear physics.

CORRECTION

In the April, 1960, issue of *Computers and Automation*, in the article "A Survey of European Digital Computers, Part 3", on page 28, second column, the title "U.S.S.R." should be inserted above the fourth paragraph from the bottom, as a heading to the section devoted to computers of the Union of Soviet Socialist Republics.

CALENDAR OF COMING EVENTS

July 5-15, 1960: Special Summer Session on Numerical Analysis for Digital Computers, The Moore School of Electrical Engineering, Univ. of Pa., Philadelphia 4, Pa.

July 19-22, 1960: USE Organization Meeting, Syracuse, N.Y.; contact James W. Nickitas, 315 Park Ave., New York, N.Y.

Aug. 6-7, 1960: 3rd Annual Conference of the Northwest Computing Association, Portland, Ore.

Aug. 8-12, 1960: Pacific General Meeting of the American Institute of Electrical Engineers, San Diego, Calif.

Aug. 10-12, 1960: Annual Meeting G-15 Users' Exchange Organization, Pittsburgh Hilton Hotel, Pittsburgh, Pa.; contact Dr. Jerry C. L. Chang, Richardson, Gordon & Associates, 3 Gateway Center, Pittsburgh 22, Pa.

Aug. 23-26, 1960: WESCON, Ambassador Hotel and Pan Pacific Auditorium, Los Angeles, Calif.

August 23-26, 1960: Annual Meeting of the Association for Computing Machinery, Marquette Univ., Milwaukee, Wisc.

Aug. 25-26, 1960: RUG Meeting (Recomp Users Group), Denver, Colo.

Aug. 29-Sept. 3, 1960: American Mathematical Society Meeting, Michigan State Univ., East Lansing, Mich.

Aug. 29-Sept. 3, 1960: 4th International Symposium on Information Theory, London, England.

Sept. 5-10, 1960: Second International Conference on Operational Research, Aix-en-Provence, France; contact John B. Lathrop, Operations Research Div., Lockheed Aircraft Corp., Burbank, Calif.

Sept. 12-16, 1960: Share XV Meeting, Pittsburgh Hilton Hotel, Pittsburgh, Pa.; contact E. B. Weinberger, Gulf Research & Development Co., P. O. Drawer 2038, Pittsburgh 30, Pa.

Sept. 19-21, 1960: 5th Annual Symposium on Space Electronics and Telemetry, sponsored by The Institute of Radio Engineers, Inc., Shoreham Hotel, Washington, D.C.

Sept. 20-24, 1960: Symposium on the Numerical Treatment of Ordinary Differential, Integral and Integro-Differential Equations, University of Rome, Rome, Italy; contact Prof. A. Ghizzetti, Provisional International Computation Ctr., Palazzo degli Uffici, Zona dell'EUR, Rome.

Sept. 22-23, 1960: Fall Meeting of the Univac Users Association, Washington, D.C.; contact W. C. Rockwell, Remington Rand, 315 Park Ave. So., New York 10, N.Y.

Sept. 26-30, 1960: 3rd ISA Instrument-Automation Conference and Exhibit of 1960, and ISA's 15th Annual Meeting, New York Coliseum, New York, N.Y.

Oct. 4-6, 1960: Meeting, Burroughs 220 Computer User Group (CUE), Philadelphia, Pa.; contact Merle D. Courson, First National Bank of San Jose, San Jose, Calif.

Oct. 9-14, 1960: 1960 Fall General Meeting of American Institute of Electrical Engineers, New York, N.Y.; contact Clarke S. Dilkes, Assoc. Dir., Burroughs Corp. Research Ctr., Paoli, Pa.

Oct. 10-12, 1960: National Electronics Conference, Hotel Sherman, Chicago, Ill.; contact Prof. Thomas F. Jones, Jr., NEC Program Chairman, School of Electrical Engrg., Purdue Univ., Lafayette, Ind.

Oct. 10-14, 1960: American Institute of Electrical Engineers, Fall General Meeting, Chicago, Ill.

Oct. 17-19, 1960: Symposium on Adaptive Control Systems, sponsored by Long Island Section, Institute of Radio Engineers, Garden City Hotel, Garden City, L.I., N.Y.; contact F. P. Caruthers, Symposium Chairman, c/o Specialties Inc., Skunks Misery Rd., Syosset, N.Y.

Oct. 19-26, 1960: Second Interkama — International Congress and Exhibition for Measuring Techniques and Automation, Düsseldorf, Germany.

Oct. 20-22, 1960: 7th International Meeting of the Institute of Management Sciences, with session "Use of Computers in Simulation," Hotel Roosevelt, New York, N.Y.; contact James Townsend, 30 E. 42 St., New York 17, N.Y.

Oct. 26-27, 1960: The 1960 Computer Applications Symposium, sponsored by Armour Research Foundation of Illinois Institute of Technology, Morrison Hotel, Chicago, Ill.; contact Andrew Ungar, Armour Res. Foundation, 10 W. 35 St., Chicago 16, Ill.

Nov. ?, 1960: 13th Annual Conference on Electronic Techniques in Medicine & Biology, sponsored by ISA with IRE and AIEE cooperating, Washington, D.C.

WORKING GROUP FOR BETTER EDUCATION

FIRST REGIONAL MEETING CAMBRIDGE, MASS. MARCH 26, 1960 — REPORT

The first regional meeting of the Working Group for Better Education was held in a morning and afternoon session on Saturday, March 26, at Mass. Inst. of Technology, Cambridge, Mass. Nineteen people were present, 3 from Connecticut, 2 from New York, 2 from New Jersey, 1 from Mexico City (Dr. Sergio Beltran, Director of the Computing Center, National Univ. of Mexico), and the remainder from Massachusetts.

W. Eugene Ferguson, Chairman, Dept. of Mathematics, Newton High School, talked on new developments in secondary mathematics courses and distributed a guide to them. Norton Levy, Chairman, Dept. of Mathematics, Corcord High School, talked on the use of community resources in Concord, consisting of some 80 professional people who have helped in the teaching of mathematics and in the pursuit of mathematical projects by students. Dr. Robert B. Davis, of Syracuse University, and the School of Mathematics Study Group at Yale, talked briefly on their program. Dr. Sergio Beltran talked on the thirst for education in Mexico, the lack of means for fulfilling it, and the tremendous energy going into the task.

At the end of the morning session, certain resolutions were discussed and passed unanimously:

—1. That membership in the WGBE should not be restricted to only members of the Association for Computing Machinery and readers of *Computers and Automation,* but that membership should be open to all seriously concerned, academically or technically trained persons, such as members of the Inst. of Radio Engineers or Amer. Inst. of Electrical Engineers or teachers of mathematics in secondary schools, etc.

—2. That the WGBE therefore could not ask the Association for Computing Machinery to pay its costs, but that it should have membership and dues.

—3. That dues should be $2 a year, for the present.

—4. That there be two officers, an Acting Treasurer and an Acting Secretary. For Acting Treasurer, Frank Verzuh was elected; for Acting Secretary, Edmund C. Berkeley was elected.

(Frank Verzuh has had to withdraw because of overload of work; Walter M. Taylor, Director of the Newton Junior College, has volunteered as Acting Treasurer.)

—5. That there should be some simple bylaws. For bylaws committee, the two officers were elected. (The bylaws committee has reported, and proposed a set of "operating rules.")

—6. That the WGBE should be a "permissive and enabling" organization, permitting and helping good work to get done with a minimum of formality.

It was agreed that six project subgroups should be started; a list of them (with members as of March 26) appears elsewhere.

For the afternoon session, seventeen people reassembled. News of the Los Angeles WGBE group, and of the Syracuse WGBE group, was reported. For the last hour and a half an open discussion took place based on agenda of 16 topics put together by those present.

Following is the list of topics on the agenda:

Discussion Agenda

1. Students' competence in communication, mathematics, humanities, and science
2. Discontinuing "recognition reading" in favor of phonics
3. Year-round use of teachers and school facilities
4. What should be taught on the high school level rather than the college level
5. Organization of groups of the WGBE
6. Interrelations among all community groups for better education
7. Use of extra community teaching resources now prevented by regulations about teacher certification
8. Drastic changes in teaching of languages, etc., as for example beginning at age 8 instead of age 12
9. Basic education vs. skill education
10. Higher salaries for teachers
11. In service training of teachers
12. Teachers' trips to conventions
13. Integration vs. compartmentalization in learning
14. Reading
15. Verifying the quality of education produced
16. Causing more young people to want to learn; the goal of giving students motivation

The people attending were: Robert B. Davis, John Bockhurst, Edward Nemeth, Loren Bullock, Sally Stevens, Walter M. Taylor, W. Eugene Ferguson, Frank M. Verzuh, Richard E. Platt, Sergio F. Beltran, Louise Peterson, Richard C. Miller, Norton Levy, Herschel N. Hadley, Mary Hadley, Janet Baker, Edmund C. Berkeley, and two persons whose names were not obtained.

SECOND REGIONAL MEETING LOS ANGELES, CALIF. APRIL 2, 1960 — REPORT

(Based on information from William A. Kegelmeyer)

The second regional meeting of the Working Group for Better Education was held in a morning and afternoon session at the Univ. of California at Los Angeles on April 2. Ten people were present. There were talks or reports from: Professor R. Clay Sprowls, Western Data Processing Center; Dr. Paul Brock, Chairman of the Association for Computing Machinery Education Committee, and Hughes Aircraft; W. A. Kegelmeyer, Ramo-Wooldridge; George E. Forsythe, Stanford University; Numerical Analysis Laboratory of the University of Arizona, a report on Project Computercade.

"We discussed at length such topics as prehigh school language courses; seminars after school hours; individual tutoring of gifted children; lecturing in the elementary grades; financial support for various projects; etc. I gave a report on the materials sent to us after the first meeting at Mass. Inst. of Technology. The working of the organization — permissive and enabling — was very well received. The philosophy of help from the group if requested, support in all projects attempted, individual initiative, etc., was discussed and agreeable."

The people attending were: Dr. Brock, Prof. Sprowls, Lodis Kovak, Bob Freeman, Frank O'Leary, Gene Hegedus, Bob Hatch, Hadassah Gilbert, Harry Weintrob, and Wm. A. Kegelmeyer.

VOLUNTARY COMPUTER TRAINING COURSE — INTEREST AND LEARNING

From: R. V. Andree, Head of the Computing Center, University of Oklahoma, Norman, Okla.

In the belief that a team consisting of a high school teacher and two or three of her top students might provide a combination of experience and enthusiasm favorable to learning, we sent out a one-page mimeographed announcement in September, 1958, stating that the University of Oklahoma would teach a selected group of such teacher-student teams to program and operate a stored-program computer. No teacher would be accepted without an accompanying student. No student would be accepted without an accompanying teacher, although one teacher might accompany several (not more than 5) students.

Since there were several competing activities on Saturdays and since the proposed program would require full day participation on alternate Saturdays for the entire semester, we expected 25-30 participants. *Over three hundred applications* were received before the deadline (two weeks after mailing the mimeographed announcement). We quickly rearranged our plans. The Oklahoma Frontiers of Science Foundation came to our rescue by providing funds to pay extra laboratory instructors and the O. U. Computing Center staff rallied to provide the other needs.

We selected 33 teachers from 32 different schools, and permitted each teacher to select from 1 to 3 students depending upon the size of the school, giving a total of 90 participants. Of the 90 participants selected, 120 showed up! It proved difficult to say "no" to the extras, some of whom were commuting almost 600 miles (round trip) to take the course, and the class was finally made up with 118 persons.

In spite of gross overcrowding, enthusiasm ran high. The resulting computer programs were well written — often ingenious. The student-teacher team seems to produce excellent results. The experiment of teaching both in the same class is highly successful. Each group has much to add to the class balance — each must hold up his prestige by doing excellent work, and the homework output is prodigious.

Perhaps the most interesting facet is that several of the teacher-student teams reconducted the class lectures for classmates back home who could not be accepted.

WORKING GROUP FOR BETTER EDUCATION

Letter to All Members

> *Purpose:* To help persons interested in better education to find each other, to know each other, to know what other people have done, and to work efficiently together on projects related to better education.

May, 1960

Dear Member of the WGBE:

We now have over 450 members, have held three meetings — in Boston, Los Angeles, and Syracuse — and have started six subgroups to work on projects.

With this letter we send you: reports on recent meetings; the preliminary operating rules; a reading list; an invitation to read and to work on projects (and a reply form); and a request for dues and contributions.

The most important thing that I see that we have to do is to become informed by reading and discussing. Our influence will be very slight if we are not informed.

The second most important thing that I see is for each of us to get started working with some other people on some "better education" project congenial to our interests; this will justify the word "WORKING" in the name of our organization. See the reply form.

It is not possible to keep functioning without income; furthermore, because there are members of the WGBE who are not members of the Association for Computing Machinery, we cannot apply to the ACM to pay our expenses. Therefore will you please consider favorably the enclosed request for dues and contributions?

Since the great majority of our members are computer people, there will be a national meeting of the WGBE on August 26 at Marquette Univ., Wisc., at the Annual Meeting, Aug. 23-26, of the Association for Computing Machinery.

Please continue to send me any ideas or comments that you have.

Yours sincerely,
Edmund C. Berkeley
Chairman, Association for Computing Machinery Secondary Education Committee
Acting Secretary, Working Group for Better Education
815 Washington St., Newtonville 60, Mass.

Walter M. Taylor
Acting Treasurer, WGBE
(Director, Newton Junior College)
206 Waverly Ave.
Newton 58, Mass.

THE WORKING GROUP FOR BETTER EDUCATION — OPERATING RULES

May 1, 1960

1. *Name and Character.* The name of this organization shall be the Working Group for Better Education. It shall be essentially an informal organization of persons working voluntarily for better education, particularly to improve the quality of education actually being produced in elementary and secondary schools.

2. *Purpose.* The purpose of the organization shall be to help persons interested in better education (1) to find each other, (2) to know each other, (3) to know what other people have accomplished, and (4) to work efficiently together on projects related to better education.

3. *Membership.* Any seriously concerned, academically or technically trained person who is interested in better education may be a member and should send his request to be a member to the Acting Secretary.

4. *Officers.* There shall be two officers, an Acting Secretary and an Acting Treasurer. These offices shall be filled by volunteers. The officers of the WGBE may and/or shall act in various ways to advance the interests of the WGBE and its members.

5. *Dues and Contributions.* For the present, dues shall be $2 per calendar year payable in January or promptly thereafter to the Acting Treasurer. Additional contributions for the better functioning of the WGBE and its parts are invited.

6. *Membership Lists.* The Acting Secretary shall mail out to members from time to time a geographically arranged list of names and addresses of members. At other times, a copy of the list or any part thereof shall be available to any member at cost on request made to the Acting Secretary.

7. *Projects.* Any member or members may form a subgroup for work on any project related to better education or for the purpose of local meetings. The Acting Secretary shall keep available for consultation by members: (1) a list of project subgroups and local geographic subgroups; (2) the name and address of the acting secretary of each subgroup; (3) a list of ideas and proposals for projects. The Acting Secretary of the WGBE shall mail out short bulletins to members from time to time. The Acting Secretary of the WGBE and any acting secretary of any subgroup may issue reports, publications, literature, bibliographies, etc., from time to time. Such reports may be mailed to members if finances permit, or may be published in the "Communications of the Association for Computing Machinery" or in "Computers and Automation" or in other ways, with notice to the members.

8. *Permissive and Enabling.* The WGBE shall be a permissive and enabling organi-

WHO'S WHO IN THE COMPUTER FIELD

From time to time we bring up to date our "Who's Who in the Computer Field." We are currently asking all computer people to fill in the following Who's Who Entry Form, and send it to us for their free listing in the Who's Who that we publish from time to time in **Computers and Automation.** We are often asked questions about computer people — and if we have up to date information in our file, we can answer those questions.

If you are interested in the computer field, please fill in and send us the following Who's Who Entry Form (to avoid tearing the magazine, the form may be copied on any piece of paper).

Name? (please print) ....

Your Address? ....

Your Organization? ....

Its Address? ....

Your Title? ....

Your Main Computer Interests?

( ) Applications
( ) Business
( ) Construction
( ) Design
( ) Electronics
( ) Logic
( ) Mathematics
( ) Programming
( ) Sales
( ) Other (specify):

....

Year of birth? ....

College or last school? ....

Year entered the computer field? ....

Occupation? ....

Anything else? (publications, distinctions, etc.) ....

....

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When you have filled in this entry form please send it to: Who's Who Editor, **Computers and Automation,** 815 Washington Street, Newtonville 60, Mass.

zation. No part of the WGBE shall prevent or stop any other part of the WGBE from working on any project that may lead to better education and that seems sensible to such other part. The Acting Secretary of the WGBE shall from time to time find out by inquiry to all members the names of any members interested in joining in the work on current or specified projects, and shall make the results of such inquiries available to members so that like-minded persons may be able to communicate with each other.

9. *Regional and Local Meetings.* Regional meetings of the Working Group for Better Education may be called by the officers or by any five members. Local meetings may be called by the acting secretary of any local group or by any three members.

Issued May 1, 1960, by the Bylaws Committee

Edmund C. Berkeley, Acting Secretary, WGBE (Editor, *Computers and Automation*) 815 Washington St., Newtonville 60, Mass.

Walter M. Taylor, Acting Treasurer, WGBE (Director, Newton Junior College) 206 Waverly Ave., Newton 58, Mass.

READING LIST

It is important that as many members of the WGBE as possible read some of the currently oustanding books related to better education, written in such a way as to throw light on the problem of better education nowadays in the United States.

Following are some suggested references:

1. Conant, Dr. James B. / The American High School Today / McGraw-Hill Book Co., 330 W. 42 St., New York, N.Y., 141 pp, $1.00
2. Rickover, H. G., Vice Admiral, U.S.N. / Education and Freedom / E. P. Dutton & Co., 300 4th Ave., New York, N.Y., 1959, 256 pp
3. King, Edmund J. / Other Schools and Ours / Rinehart & Co., 232 Madison Ave., New York, N.Y., 1958, 234 pp
4. various authors / Great Issues in Education (3 vols.) / Great Books Foundation, 37 So. Wabash Ave., Chicago, Ill., 1956
5. Terman, Sibyl, and Charles Child Walcutt / Reading: Chaos and Cure / McGraw-Hill Book Co., 330 W. 42 St., New York, N.Y., 1958, 285 pp, $4.75
6. Council for Basic Education, editor James D. Koerner, Exec. Secretary / The Case for Basic Education — A Program of Aims for Public Schools / Little, Brown & Co., 34 Beacon St., Boston, Mass., 256 pp, $4.00
7. Kentucky Special House Committee to Investigate the Dept. of Education, Harry M. Caudill, Chairman / Report of Special Committee to Investigate Education, to the House of Representatives of the Kentucky General Assembly / Legislative Research Commission, Frankfort, Ky., 49 pp

Computers and Data Processing in a National Peace Agency

The following bill, H.R. 9305, which was introduced into the House of Representatives of the U.S. Congress by Congressman Charles E. Bennett of Jacksonville, Florida, relating to a National Peace Agency, indicates a number of new areas for the application of computers and data processing:

A BILL

To create and prescribe the functions of a National Peace Agency.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

Short Title

SECTION 1. This Act may be cited as the "National Peace Agency Act."

Statement of Purpose

SEC. 2. It is the purpose of this Act to deal with problems related to achieving peace through arms limitation agreements, to developing international control and inspection systems to enforce such agreements, and to applying scientific and technical resources to promote peace by eliminating or reducing the economic causes of war.

Creation and Functions of National Peace Agency

SEC. 3. There is hereby established the National Peace Agency (hereinafter called the "Agency"). The Agency shall undertake programs to carry out the purpose of this Act, including, among others, programs —

(1) for research and development bearing upon the science and technology of nuclear test monitoring,

(2) for design, engineering and testing of experimental systems for monitoring nuclear tests,

(3) for research and development relating to systems and instruments for detecting and identifying missile and satellite tests,

(4) for design, engineering and testing of experimental systems for monitoring missile and satellite tests,

(5) for development and testing of satellites for monitoring nuclear tests in cosmic space,

(6) for research and development in the techniques of aerial reconnaissance inspection,

(7) for research and development relating to overall problems of disarmament, arms limitations, and inspection and control systems,

(8) for development and application of communications and advanced computer techniques for analyzing the problems involved in inspection of national budgets and economic indicators as they bear upon disarmament inspection systems,

(9) for development of new analytic organizations to —

(A) apply the techniques of operations research to peace problems in the same way that "war gaming" is conducted for the military problems,

(B) generate new ideas and concepts applicable to systems and techniques for arms limitation,

(C) conduct general disarmament studies.

(10) for support of studies and research on projects such as —

(A) techniques for limiting the use of space for military purposes,

(B) techniques associated with communications systems for inspection purposes,

(C) techniques relating to conventional armament inspection and detection systems,

(D) inspection techniques involved in limited warfare situations,

(E) surprise attack detection systems,

(F) monitoring techniques appropriate to the submarine problem,

(G) legal aspects of national sovereignty extended to the space domain and freedom of the seas, insofar as they contribute to the possibility of war,

(H) analyses of the effects of disarmament agreements upon national economies, and

(I) scientific and technical problems which contribute to the possibility of war.

(11) to investigate on a continuing basis the broad aspects of the effects of radiation upon man,

(12) for research on educational techniques aimed at rendering underveloped nations less technologically dependent, insofar as their

ADVERTISING INDEX

Following is the index of advertisements. Each item contains: Name and address of the advertiser / page number where the advertisement appears / name of agency if any.

Berkeley Enterprises, Inc., 815 Washington St., Newtonville 60, Mass. / Page 2 / —

C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Ill. / Page 9 / Reincke, Meyer & Finn

Philco Corp., Government & Industrial Group, Computer Div., 3900 Welsh Rd., Willow Grove, Pa. / Page 3 / Maxwell Associates. Inc.

System Development Corp., 2406 Colorado Ave., Santa Monica, Calif. / Page 24 / Fuller & Smith & Ross, Inc.

Technical Operations, Inc., 3520 Prospect St., N.W., Washington 7, D.C. / Page 15 / Dawson MacLeod & Stivers

Wheeler, Fairchild, Inc., 610 So. Arroyo Parkway, Pasadena, Calif. / Page 16 / —

dependence contributes to the possibility of war,

(13) for research and development on problems of underdeveloped nations, insofar as they contribute to the possibility of war, in such areas as food production, conservation of mineral and water resources (including desalination of sea and brackish water), practical power-generating systems, and medicine and health,

(14) for research in meeting adequately the tensions created by overconcentration of population in some areas and inadequate population in other areas of the world.

Laboratory for Peace

SEC. 4. The Director of the Agency shall establish in the Agency a Laboratory for Peace through which the Agency shall develop and administer its research and study programs. In carrying on such programs the Agency shall enter into contracts with educational and research institutions within the United States and abroad with a view to obtaining the benefits of scientific and intellectual resources, wherever located in the world.

Relationship with Other Agencies

SEC. 5. The President shall establish procedure designed to insure that the Agency will carry out its functions in close collaboration with the other agencies of the Government, but without duplicating the efforts of any such agency. Such procedures shall also provide that information available to other agencies will be made available to the National Peace Agency, and shall prescribe other means by which other agencies of the Government may support the efforts of the National Peace Agency.

Director and Deputy Director of the Agency

SEC. 6. (a) The Agency shall be headed by a Director, who shall be appointed by the President by and with the advice and consent of the Senate, and shall receive compensation at the rate of $22,500 per annum. Under the supervision and direction of the President, the Director shall be responsible for the exercise of all powers and the discharge of all duties of the Agency, and shall have authority and control over all personnel and activities thereof.

(b) There shall be in the Agency a Deputy Director, who shall be appointed by the President by and with the advice and consent of the Senate, shall receive compensation at the rate of $21,500 per annum, and shall perform such duties and exercise such powers as the Director may prescribe. The Deputy Director shall act for, and exercise the powers of, the Director during his absence or disability.

Administration

SEC. 7. (a) In the performance of its functions the Agency is authorized —

(1) to make, promulgate, issue, rescind, and amend rules and regulations governing the manner of its operations and the exercise of the powers vested in it by law;

(2) to appoint and fix the compensation of such officers and employees as may be necessary to carry out such functions. Such officers and employees shall be appointed in accordance with the civil-service laws and their compensation fixed in accordance with the Classification Act of 1949;

(3) to accept unconditional gifts or donations of services, money, or property, real, personal, or mixed, tangible or intangible;

(4) without regard to section 3648 of the Revised Statutes, as amended (31 U.S.C. 529), to enter into and perform such contracts, leases, cooperative agreements, or other transactions as may be necessary in the conduct of its work and on such terms as it may deem appropriate, with any agency or instrumentality of the United States, or with any State, territory, or possession, or with any political subdivision thereof, or with any person, firm, association, corporation, or educational institution. To the maximum extent practicable and consistent with the accomplishment of the purpose of this Act, such contracts, leases, agreements, and other transactions shall be allocated by the Director in a manner which will enable small-business concerns to participate equitably and proportionately in the conduct of the work of the Agency;

(5) to use, with their consent, the services, equipment, personnel, and facilities of Federal and other agencies with or without reimbursement, and on a similar basis to cooperate with other public and private agencies and instrumentalities in the use of services, equipment, and facilities. Each department and agency of the Federal Government shall cooperate fully with the Agency in making its services, equipment, personnel, and facilities available to the Agency, and any such department or agency is authorized, notwithstanding any other provision of law, to transfer to or to receive from the Agency, without reimbursement, supplies and equipment other than administrative supplies or equipment;

(6) to appoint such advisory committees as may be appropriate for purposes of consultation and advice to the Agency in the performance of its functions;

(7) to establish within the Agency such offices and procedures as may be appropriate to provide for the greatest possible coordination of its activities under this Act with related activities being carried on by other public and private agencies and organizations;

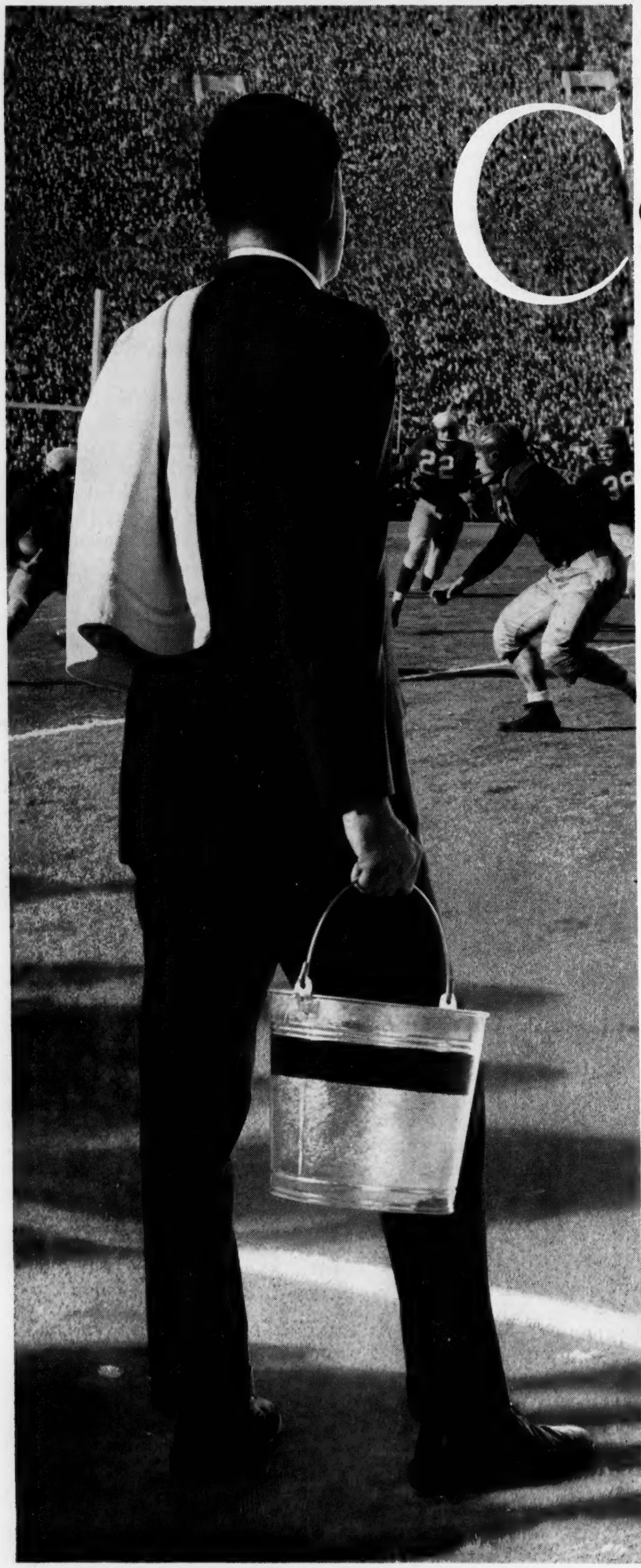
(8) when determined by the Director to be necessary, and subject to such security investigations as he may determine to be appropriate, to employ aliens without regard to statutory provisions prohibiting payment of compensation to aliens;

(9) to employ retired commissioned officers of the Armed Forces of the United States and compensate them at the rate established for the positions occupied by them within the Administration, subject only to the limitations in pay set forth in section 212 of the Act of June 30, 1932, as amended (5 U.S.C. 59a); and

(10) with the approval of the President, to enter into cooperative agreements under which members of Army, Navy, Air Force, and Marine Corps may be detailed by the appropriate Secretary for services in the performance of functions under this Act to the same extent as that to which they might be lawfully assigned in the Department of Defense.

Information and Security

SEC. 8. In order to promote the free flow and exchange of new ideas and concepts in the new technology of peace research and development, the Agency shall, so far as possible, have all research efforts of the Agency performed in subject matter not requiring classification for security purposes. Nothing in this Act shall be deemed to change or modify security procedures or to exempt personnel of the Agency from being required to obtain security clearance before obtaining classified information.



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